Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XL. NEW YORK, SATURDAY, DECEMBER 20, 1902. No. 25.

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

114 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

EUROPEAN OFFICE, - - - - - - - - - - - A. C. Shaw, Manager.
Hastings House, Norfolk St., Strand, London, England.

T. C. MARTIN AND W. D. WEAVER, - - - - - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - - - Associate Editor.

NOTICE TO READERS
WHO ARE NOT SUBSCRIBERS.

The ELECTRICAL WORLD AND ENGINEER is not returnable from the newsdealer. If you desire to purchase the paper from a dealer it will be to your advantage to notify him that you will want it, in order to insure his having a copy for you. If you wish to receive the paper regularly, please send in your subscription so that we can mail it to you direct.

Single copies are 10 cents each. The 52 copies for the entire year cost $3.00 in advance. Please send remittance with your subscription order.

ELECTRICAL WORLD AND ENGINEER.

SPECIAL ANNOUNCEMENT TO ADVERTISERS.

The attention of advertisers is directed to an important announcement appearing on page xviii of the advertising section of this issue, on the subject of the new schedule of advertising rates taking effect January 1, 1903.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER by 10 A. M. MONDAY of the week of issue, New advertisements can be received up to noon of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - - - per year, $3.00
Foreign Countries, within the Postal Union, - - - - - - - - - - - 6.00
Great Britain and Ireland, - - - - - - - - - - - - - - - - 25 shillings
Germany, - 25 marks
France, - 31 francs
Single Copies, - .10

Remittances for foreign subscriptions may be made through our European office.

In requesting your address changed give OLD as well as new address.

Copyright, 1902, by ELECTRICAL WORLD AND ENGINEER, Incorporated.

Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, DECEMBER 20, 1902.

CONTENTS.

Editorial 989
The Sleet Break-Down of the Manhattan System 992
International Congresses at the St. Louis World's Fair 992
Ruhmer's Photoelectric Telephone. By A. Frederick Collins 993
Some Notes on Illumination. By Bassett Jones, Jr. 995
Telephone Cables—III. By Arthur V. Abbott, C. E. 996
Opportunities in Italy and Sicily 998
French System of Train Lighting. By P. Letheule 999
A Theory of Magnetism. By Johannes Zacharias 1000
The Production of Calcium and Strontium. By H. Danneel 1002
The Armature Reaction of Alternators—VII. By C. F. Guilbert 1003
Recent Electrochemical Developments. By Clinton Paul Townsend 1004
New Telephone Patents 1005
Changes in the National Electric Code 1006
Telephone Law in Ohio 1007
Pro and Con of Interurban Trolleys 1007
How to Deal with City Congestion 1007
Letter Boxes on Trolley Cars 1008
London Underground Roads 1008
A New Trolley Bridge for Greater New York 1008
Current News and Notes 1008
LETTER TO THE EDITORS:
The Size of Atoms. By H. V. Ridout 1009
Digest of Current Electrical Literature 1010
Surface Electric Locomotives 1013
The Moore System of Vacuum-Tube Lighting 1015
Large Electric Crane in Railroad Shops 1016
DEPARTMENTS:
Financial Intelligence 1017
Commercial Intelligence 1018
General News 1020
Trade Notes 1023
Record of Electrical Patents 1024
Moonlight Schedules for 1903 ..... Supplement

MOONLIGHT TABLES.

As our readers are aware, this journal has for some years past made a practice of publishing, early in December, moonlight tables for street lighting work, to be used in the ensuing year. These tables have always been compiled for us by Mr. H. W. Frund, a well-known electric light manager. With the present issue we furnish as a Supplement, in the familiar form, Mr. Frund's tables for 1903, his own table and the standard moonlight system appearing side by side. We are glad to know that this effort is much appreciated, as evidenced not only by the inquiry for tables, but by their frequent appearance on the walls of electric lighting offices and central stations. Extra copies may be obtained on application to the business department of this journal.

MANHATTAN ELEVATED ELECTRICS.

As all our readers who live in New York are aware, and as many of them who live outside have also learned, the electric third-rail system of the Manhattan Elevated Company went very rapidly and thoroughly to pieces last week, during the occurrence of a rather ordinary sleet storm, which, under usual conditions, would not have attracted much attention. But the wonted hardships that New Yorkers endure were so intensified during the recent episode and the comment created has been so unfair to electricity as a motive power, we are constrained to enter a strenuous protest, rather from a sense of duty than because we want to say anything. It is not our common practice to rail at corporations charged with great public functions, but on the contrary, to defend them very frequently from the complaints that are laid against them. But in the present instance when a great transportation system by woeful lack of foresight and energy allows the cause of electric traction to suffer criticism for which there is no warrant, we do not propose to stand by and acquiesce quietly. In our opinion the misery inflicted on hundreds of thousands of New Yorkers was wholly unnecessary, and we hardly wonder that many people have looked for a malign explanation of what happened. We have heard it suggested that owing to the presence of New York Central influences in the Manhattan management, there was great willingness to let the public see that the third-rail method was quite uncertain and unreliable in times of stress. Such an idea ought to be dismissed, even if it chimes in with the Central's elaborate procrastination over changes in the tunnel. Another theory handed around in electrical circles is that the Manhattan managers have been far too busy fostering profitable stock deals to see to it that the proper equipment and necessary supplies were secured in time from the manufacturers, whom other electrical service companies have been persecuting with pertinacious demands for material. We mention these things merely to show what sinister interpretations people are willing to proffer when suffering from evils that appear to them absolutely unnecessary and very easily prevented.

When we remember and recall how magnificently Mr. Vreeland has handled the Metropolitan Street Railway system in New York in violent snow and sleet storms, catching the flakes even before they could reach not merely his third rail, but his fourth, below the level of the swimming streets, it is too late for the Manhattan people to convince us or anybody else that the third rail is a failure on a track free from every possible obstruction and accessible to the promptest removal of, and prevention of clogging by, ice or snow. The third rail will yet be improved upon, but we insist that it is a splendid success

in competent hands, and we refuse to have the Manhattan slackness and fizzle regarded as proof of what energetic management can do with appliances already approved in Chicago, Boston and other places. There are various forms of third rail, and the tardy discovery on the Manhattan system that one of the simplest styles can be knocked out by a trivial "cold snap" is altogether too preposterous to be allowed for a second. If there are better methods, for sectional operation, for housing the rail, or for scraping the contact head,—and we can readily believe in such improvements—we still contend and insist that there was no excuse for the frightful inconveniences caused last week. Those inconveniences are after all but in keeping with the record of the past—the miserable station management, the wretched lighting, the incessant delays, the quick interruptions of the express service, and half a dozen other features of gratuitous discomfort. It has been said that the parsimony of Mr. Sage was largely to blame for all that; but now that he is happily removed from further opportunity of distressing his fellow-citizens, it is devoutly to be hoped that others, if equally responsible, will disappear under the new regime. We are entitled to expect better things.

ATOMIC DIMENSIONS.

In our correspondence columns this week appears a letter from Mr. Ridout, referring to our editorial comments on his recent paper. We are glad that he likes the term "bicron" for $\mu\,\mu$, the billionth of a metre, or 10^{-9} metre, to match and correspond in the descending scale with the well-established micron, the millionth of a metre. Similarly we may use with advantage the "tricron," or $\mu\,\mu\,\mu$, for the trillionth of a metre; or 10^{-12} metre. Both these terms "bicron" and "tricron" are badly needed in microphysics, and they are self-explanatory. It is convenient to use them first and to ask philologists about them afterwards, because philologists as a class protest against the introduction of any new term, and new terms must be had in a growing science and art.

IMPROVEMENTS IN ARC LIGHTING.

We note with interest that the development of arc lighting by means of carbons charged with relatively volatile substances is being steadily pursued abroad. In this country little has been done along that line save in a purely experimental way, yet we know of few directions to which earnest work could be devoted with better prospects of success. Certain it is that such arcs can reach an efficiency much higher than is found in current practice, and with great advantage to the color of the resulting light. And there is good reason for this. As we have more than once pointed out, attempts at improving the efficiency of illuminants have proceeded along two diverging lines. On the one hand, recognizing the low efficiency of the light given by incandescent solids at ordinary high temperatures, there has been steady effort to find substances so refractory that they can be carried without immediate danger of disintegration to a temperature much higher than usual. This results in an increased proportion of radiation within the limits of the visible spectrum. To this class belong the iridium lamp in various modifications, the Nernst lamp and the arc between refractory pencils similar to the Nernst glower. There is no doubt that by such means the efficiency of the light can be greatly increased, perhaps nearly or quite doubled. Against the process stands, aside from the mechanical difficulties which have been encountered, the very high intrinsic brilliancy of the resulting light, rendering absolutely necessary for most purposes the use of much denser shades and more elaborate diffusive devices than are necessary with ordinary illuminants. This is equivalent to a lessened efficiency.

If one has two lights, one of so low intrinsic brilliancy that it can be used unshaded, the other so brilliant that it requires a heavy opal shade to make it bearable, the latter must have nearly double the efficiency of the former in order to have practical efficiency. For to give a unit of light, say, a single candle-power, the same working value in each case, the intrinsic brilliancy of the two sources including shades must be equal, at least if they are in any sense within the field of vision. Otherwise, in the presence of the brighter light the eye will be automatically stopped down at somewhere about f 6 in ordinary illumination. The extent to which the iris shuts or opens depends on the maximum intensity of the stimulus; that is, on the maximum luminous intensity within the field of vision. In very dim light the iris may open to f 4, or even wider, while in the presence of a very brilliant source of light it will close to f 16, or so. Thus when one is driving along a dark street and approaches an arc lamp, the eye is reduced to a condition of uselessness as regards the faintly illuminated objects outside of the immediate range of the arc. It is even worse than the similar photographic case, because one cannot correct the under exposure by adroit development. Thus gaining luminous efficiency by pushing up the temperature of the incandescent source results in certain inconveniences and losses in the application of the light that tend to limit the practical usefulness of the method. The real gain is in this case far less than the apparent gain.

The other plan for increasing luminous efficiency is to employ sources of light which are characterized by selective radiation, thus causing a greater proportion of the total energy to be concentrated in the visible spectrum. In this category fall vacuum-tube lamps and the arcs which we have under consideration. The two categories are not absolutely distinct, for there is a minor degree of selective radiation in the substances of which the Nernst glower is formed, and the common enclosed arc is strongly selective as regards the rays photographically active, but the main difference is fully preserved, nevertheless. The vacuum tube, with its discontinuous spectrum, is highly efficient, but as ill luck will have it, the only form yet commercial is very bad in color. Now the effect of incorporating metallic salts in the carbons of an arc is to superpose on the radiation of the glowing carbon a strongly selective radiation due to the metallic vapors, resulting in a very considerable increase of efficiency without proportionally increasing the intrinsic brilliancy. In theory, therefore, it is an admirable plan, and the results already obtained show a very high efficiency. The dubious factors to be dealt with are the uniformity of the results and the unusual mass of matter volatilized. The former implies careful attention to the details of manufacture, and the latter will undoubtedly require a good deal of experimentation to avoid smudging the lamp with metallic oxides, particularly if such electrodes are ever to be used with enclosed arcs. This means very careful choice of the volatile substances and plenty of hard work in reaching a commercial result. But the light is so efficient and can be made so excellent in color, that it is well worth exhaustive investigation. The more volatile the active substances the lower will be the intrinsic brilliancy and the greater the danger of smudging, so that the experimenter is between two fires. Still, there seems an excellent chance of a good commercial result and we hope that the American workers will do their full share.

SELF-DENYING ORDINANCES.

The report which we gave in our eight-page Supplement last week of the independent telephone convention in Chicago contained a good many features of interest and importance, quite aside from technical questions which somehow do not yet come

up very prominently in these meetings. Doubtless as the commercial problems get settled those of an engineering nature will loom up more conspicuously, and with the greater speed as the campaign is pushed to secure capital. We are glad to note the emphasis laid upon good engineering work by those who spoke as to the claims of independent telephony for investment. The necessity for solid, enduring construction and for the use of the best apparatus has never been more strenuously advocated than it was last week by those who discussed investment in telephony by the banker and by the small investor. We fear that some of the seed will not fall on ground that is receptive; but there has of late been great improvement in general construction and some of the independent exchanges are not to be surpassed.

In view of the fierceness with which many of the independent exchanges have insisted upon their right to have access to Bell circuits, under common carrier law and principles of equity, it is rather astonishing to see the case "given away" by the self-denying ordinance adopted at Chicago, pledging the members of the Association to purge it of all managers who exchange business with the Bell system. Apparently the rights and welfare of the public are clean forgotten by those who but a year or two ago were posing as the heaven-sent deliverers of the public from a tyrannical monopoly. If, now, managers who, to facilitate the business of their customers, are willing to exchange with rivals shall be boycotted and bounced, we do not see that the independents acting that way are one whit better than the folks they were lately denouncing. We are reminded of the Puritans who came to New England to escape persecution and became very harsh persecutors themselves, and we deplore the appearance of such a spirit in the independent ranks. In the early days of electric lighting there was somewhat the same tendency as between incandescent and arc lighting companies, but it was long ago obliterated by the march of events and by a larger, wider conception of what are the duties of an electric light company, and what are the rights of the public to enjoy every facility and assistance that can be afforded. We know that there are many thoughtful, liberal-minded men in the independent telephone field who see that it ill becomes them to deny rights and privileges which they have themselves been vehemently claiming but a moment ago.

Another outcropping of commercial jealousies is seen again in the resolution not to deal with a well-known manufacturing concern because it is owned and controlled by American Bell interests. This is somewhat like the action taken earlier in the year by the National independent telephone body, at its Philadelphia convention, and is, of course, a frank and avowed boycott. It is also in keeping with the proposal to discipline the independent manufacturers who insist on selling an exchange system in a place where one already competes. Obviously a wide field of conjecture and controversy is here opened up, and the parallel with the electrical history of the recent past in light and power is again rather strikingly close. Even when such policy is wholly righteous, it is hard to enforce with full severity, and if not carried out logically it generally fails. Here also the public views with quick suspicion and animosity such movements, as in restraint of trade; and we hardly think it will regard favorably the action of those it has been backing up pretty vigorously as the advocates of an open-door, free-for-all policy. Besides, it might be claimed that the apparatus had been bought from the concern first named, because it was at once the cheapest and best, enabling service to be given reasonably. The case of manufacturers selling rival systems in places already blessed with competition is slightly more complex. Usually such competition leads to low rates at first, but after a time consolidation sets in and then the investment and the price of service are loaded with the cost of the junk pile. On the other hand, absence of competition has an undeniable tendency to cause the degeneracy of a system, and the problem is to set the point where efficiency shall be maintained at the highest pitch with least effort on the part of capital and labor.

MAGNETIC DECLINATION TABLES.

The United States Coast and Geodetic Survey has recently issued a book containing magnetic declination tables and isogonic charts for 1902, as prepared by Mr. L. A. Bauer. This volume is quite a compendium of facts relating to terrestrial magnetism and is of great interest to the student of magnetism. It brings into prominence a number of facts that are difficult to discover amid the vast array and maze of modern magnetic literature.

The tables are particularly interesting in their data of secular variations, which variations may be due to secondary electric currents, generated within the earth's mass, by its rotation about an axis not coincident with the magnetic axis. Considering the earth as a conducting mass, and also as a permanent magnet, if the earth's rotation axis and the magnetic axis were one and the same, then, by symmetry, the electromotive forces of the "unipolar" dynamo type, induced in the rotating mass, would be symmetrically distributed about the globe, and would balance one another in such a manner that no electric currents would flow, in the absence of conductors to join the northern and southern polar regions. But with the magnetic and rotational axes eccentric, the induced electromotive forces in the mass of the earth would not balance, and would establish a set of eddy currents in the earth, the distribution depending upon the local conductivity. The effects of these eddy currents would be to modify the original inducing flux distribution, to influence whatever permanent magnetic distribution might exist, and to affect compass needles on the surface to a greater or less extent. The general deductions seem to be that the earth's magnetic flux distribution, which compass needles obey, is partly of a steady or permanent type, like that of a bar magnet, partly due to electric currents in the earth, which may be subject to fluctuation, and partly due to external or cosmical influences, such as auroral currents or electric currents in the rarer regions of the atmosphere, where the air is supposed to be a good conductor, at an elevation of, say, fifty miles.

A very interesting indication has been evolved as the outcome of recent elaborate magnetic surveys of England and France. The charts of isogonic lines, when carefully drawn, show some local wrinkles, like "faults" in geological strata. A very noticeable line of kinks in isogonals appears near Paris. By analyzing the charted distribution into a uniform distribution, and a superposed irregularity, the irregularity takes the form of a ridge or line of virtual magnetic matter having a definite geographical contour. It is stated by Professor Rücker in a passage quoted from his report of the British Survey, that these magnetic ridges correspond, in general, with observed masses of basalt rock. Although basalt is not itself a sufficiently magnetic substance to account for the whole magnetic protuberance, yet it would appear likely that magnetic rocks underlie and accompany the basaltic obtrusion; so that the magnetic charts may be found capable of yielding valuable geological inferences. Another interesting fact is that some remarkable automatic magnetic records from the magnetic observatory at Cheltenham, Md., seem to indicate sudden disturbances of a magnetic, as distinguished from a seismic nature, about the times of the first and second eruptions of Mont Pelee in Martinique.

in competent hands, and we refuse to have the Manhattan slackness and fizzle regarded as proof of what energetic management can do with appliances already approved in Chicago, Boston and other places. There are various forms of third rail, and the tardy discovery on the Manhattan system that one of the simplest styles can be knocked out by a trivial "cold snap" is altogether too preposterous to be allowed for a second. If there are better methods, for sectional operation, for housing the rail, or for scraping the contact head,—and we can readily believe in such improvements—we still contend and insist that there was no excuse for the frightful inconveniences caused last week. Those inconveniences are after all but in keeping with the record of the past—the miserable station management, the wretched lighting, the incessant delays, the quick interruptions of the express service, and half a dozen other features of gratuitous discomfort. It has been said that the parsimony of Mr. Sage was largely to blame for all that; but now that he is happily removed from further opportunity of distressing his fellow-citizens, it is devoutly to be hoped that others, if equally responsible, will disappear under the new regime. We are entitled to expect better things.

Atomic Dimensions.

In our correspondence columns this week appears a letter from Mr. Ridout, referring to our editorial comments on his recent paper. We are glad that he likes the term "bicron" for $\mu\,\mu$, the billionth of a metre, or 10^{-9} metre, to match and correspond in the descending scale with the well-established micron, the millionth of a metre. Similarly we may use with advantage the "tricron," or $\mu\,\mu\,\mu$, for the trillionth of a metre; or 10^{-12} metre. Both these terms "bicron" and "tricron" are badly needed in microphysics, and they are self-explanatory. It is convenient to use them first and to ask philologists about them afterwards, because philologists as a class protest against the introduction of any new term, and new terms must be had in a growing science and art.

Improvements in Arc Lighting.

We note with interest that the development of arc lighting by means of carbons charged with relatively volatile substances is being steadily pursued abroad. In this country little has been done along that line save in a purely experimental way, yet we know of few directions to which earnest work could be devoted with better prospects of success. Certain it is that such arcs can reach an efficiency much higher than is found in current practice, and with great advantage to the color of the resulting light. And there is good reason for this. As we have more than once pointed out, attempts at improving the efficiency of illuminants have proceeded along two diverging lines. On the one hand, recognizing the low efficiency of the light given by incandescent solids at ordinary high temperatures, there has been steady effort to find substances so refractory that they can be carried without immediate danger of disintegration to a temperature much higher than usual. This results in an increased proportion of radiation within the limits of the visible spectrum. To this class belong the iridium lamp in various modifications, the Nernst lamp and the arc between refractory pencils similar to the Nernst glower. There is no doubt that by such means the efficiency of the light can be greatly increased, perhaps nearly or quite doubled. Against the process stands, aside from the mechanical difficulties which have been encountered, the very high intrinsic brilliancy of the resulting light, rendering absolutely necessary for most purposes the use of much denser shades and more elaborate diffusive devices than are necessary with ordinary illuminants. This is equivalent to a lessened efficiency.

If one has two lights, one of so low intrinsic brilliancy that it can be used unshaded, the other so brilliant that it requires a heavy opal shade to make it bearable, the latter must have nearly double the efficiency of the former in order to have practical efficiency. For to give a unit of light, say, a single candle-power, the same working value in each case, the intrinsic brilliancy of the two sources including shades must be equal, at least if they are in any sense within the field of vision. Otherwise, in the presence of the brighter light the eye will be automatically stopped down at somewhere about f 6 in ordinary illumination. The extent to which the iris shuts or opens depends on the maximum intensity of the stimulus; that is, on the maximum luminous intensity within the field of vision. In very dim light the iris may open to f 4, or even wider, while in the presence of a very brilliant source of light it will close to f 16, or so. Thus when one is driving along a dark street and approaches an arc lamp, the eye is reduced to a condition of uselessness as regards the faintly illuminated objects outside of the immediate range of the arc. It is even worse than the similar photographic case, because one cannot correct the under exposure by adroit development. Thus gaining luminous efficiency by pushing up the temperature of the incandescent source results in certain inconveniences and losses in the application of the light that tend to limit the practical usefulness of the method. The real gain is in this case far less than the apparent gain.

The other plan for increasing luminous efficiency is to employ sources of light which are characterized by selective radiation, thus causing a greater proportion of the total energy to be concentrated in the visible spectrum. In this category fall vacuum-tube lamps and the arcs which we have under consideration. The two categories are not absolutely distinct, for there is a minor degree of selective radiation in the substances of which the Nernst glower is formed, and the common enclosed arc is strongly selective as regards the rays photographically active, but the main difference is fully preserved, nevertheless. The vacuum tube, with its discontinuous spectrum, is highly efficient, but as ill luck will have it, the only form yet commercial is very bad in color. Now the effect of incorporating metallic salts in the carbons of an arc is to superpose on the radiation of the glowing carbon a strongly selective radiation due to the metallic vapors, resulting in a very considerable increase of efficiency without proportionally increasing the intrinsic brilliancy. In theory, therefore, it is an admirable plan, and the results already obtained show a very high efficiency. The dubious factors to be dealt with are the uniformity of the results and the unusual mass of matter volatilized. The former implies careful attention to the details of manufacture, and the latter will undoubtedly require a good deal of experimentation to avoid smudging the lamp with metallic oxides, particularly if such electrodes are ever to be used with enclosed arcs. This means very careful choice of the volatile substances and plenty of hard work in reaching a commercial result. But the light is so efficient and can be made so excellent in color, that it is well worth exhaustive investigation. The more volatile the active substances the lower will be the intrinsic brilliancy and the greater the danger of smudging, so that the experimenter is between two fires. Still, there seems an excellent chance of a good commercial result and we hope that the American workers will do their full share.

Self-Denying Ordinances.

The report which we gave in our eight-page Supplement last week of the independent telephone convention in Chicago contained a good many features of interest and importance, quite aside from technical questions which somehow do not yet come

up very prominently in these meetings. Doubtless as the commercial problems get settled those of an engineering nature will loom up more conspicuously, and with the greater speed as the campaign is pushed to secure capital. We are glad to note the emphasis laid upon good engineering work by those who spoke as to the claims of independent telephony for investment. The necessity for solid, enduring construction and for the use of the best apparatus has never been more strenuously advocated than it was last week by those who discussed investment in telephony by the banker and by the small investor. We fear that some of the seed will not fall on ground that is receptive; but there has of late been great improvement in general construction and some of the independent exchanges are not to be surpassed.

In view of the fierceness with which many of the independent exchanges have insisted upon their right to have access to Bell circuits, under common carrier law and principles of equity, it is rather astonishing to see the case "given away" by the self-denying ordinance adopted at Chicago, pledging the members of the Association to purge it of all managers who exchange business with the Bell system. Apparently the rights and welfare of the public are clean forgotten by those who but a year or two ago were posing as the heaven-sent deliverers of the public from a tyrannical monopoly. If, now, managers who, to facilitate the business of their customers, are willing to exchange with rivals shall be boycotted and bounced, we do not see that the independents acting that way are one whit better than the folks they were lately denouncing. We are reminded of the Puritans who came to New England to escape persecution and became very harsh persecutors themselves, and we deplore the appearance of such a spirit in the independent ranks. In the early days of electric lighting there was somewhat the same tendency as between incandescent and arc lighting companies, but it was long ago obliterated by the march of events and by a larger, wider conception of what are the duties of an electric light company, and what are the rights of the public to enjoy every facility and assistance that can be afforded. We know that there are many thoughtful, liberal-minded men in the independent telephone field who see that it ill becomes them to deny rights and privileges which they have themselves been vehemently claiming but a moment ago.

Another outcropping of commercial jealousies is seen again in the resolution not to deal with a well-known manufacturing concern because it is owned and controlled by American Bell interests. This is somewhat like the action taken earlier in the year by the National independent telephone body, at its Philadelphia convention, and is, of course, a frank and avowed boycott. It is also in keeping with the proposal to discipline the independent manufacturers who insist on selling an exchange system in a place where one already competes. Obviously a wide field of conjecture and controversy is here opened up, and the parallel with the electrical history of the recent past in light and power is again rather strikingly close. Even when such policy is wholly righteous, it is hard to enforce with full severity, and if not carried out logically it generally fails. Here also the public views with quick suspicion and animosity such movements, as in restraint of trade; and we hardly think it will regard favorably the action of those it has been backing up pretty vigorously as the advocates of an open-door, free-for-all policy. Besides, it might be claimed that the apparatus had been bought from the concern first named, because it was at once the cheapest and best, enabling service to be given reasonably. The case of manufacturers selling rival systems in places already blessed with competition is slightly more complex. Usually such competition leads to low rates at first, but after a time consolidation sets in and then the investment and the price of service are loaded with the cost of the junk pile. On the other hand, absence of competition has an undeniable tendency to cause the degeneracy of a system, and the problem is to set the point where efficiency shall be maintained at the highest pitch with least effort on the part of capital and labor.

MAGNETIC DECLINATION TABLES.

The United States Coast and Geodetic Survey has recently issued a book containing magnetic declination tables and isogonic charts for 1902, as prepared by Mr. L. A. Bauer. This volume is quite a compendium of facts relating to terrestrial magnetism and is of great interest to the student of magnetism. It brings into prominence a number of facts that are difficult to discover amid the vast array and maze of modern magnetic literature.

The tables are particularly interesting in their data of secular variations, which variations may be due to secondary electric currents, generated within the earth's mass, by its rotation about an axis not coincident with the magnetic axis. Considering the earth as a conducting mass, and also as a permanent magnet, if the earth's rotation axis and the magnetic axis were one and the same, then, by symmetry, the electromotive forces of the "unipolar" dynamo type, induced in the rotating mass, would be symmetrically distributed about the globe, and would balance one another in such a manner that no electric currents would flow, in the absence of conductors to join the northern and southern polar regions. But with the magnetic and rotational axes eccentric, the induced electromotive forces in the mass of the earth would not balance, and would establish a set of eddy currents in the earth, the distribution depending upon the local conductivity. The effects of these eddy currents would be to modify the original inducing flux distribution, to influence whatever permanent magnetic distribution might exist, and to affect compass needles on the surface to a greater or less extent. The general deductions seem to be that the earth's magnetic flux distribution, which compass needles obey, is partly of a steady or permanent type, like that of a bar magnet, partly due to electric currents in the earth, which may be subject to fluctuation, and partly due to external or cosmical influences, such as auroral currents or electric currents in the rarer regions of the atmosphere, where the air is supposed to be a good conductor, at an elevation of, say, fifty miles.

A very interesting indication has been evolved as the outcome of recent elaborate magnetic surveys of England and France. The charts of isogonic lines, when carefully drawn, show some local wrinkles, like "faults" in geological strata. A very noticeable line of kinks in isogonals appears near Paris. By analyzing the charted distribution into a uniform distribution, and a superposed irregularity, the irregularity takes the form of a ridge or line of virtual magnetic matter having a definite geographical contour. It is stated by Professor Rücker in a passage quoted from his report of the British Survey, that these magnetic ridges correspond, in general, with observed masses of basalt rock. Although basalt is not itself a sufficiently magnetic substance to account for the whole magnetic protuberance, yet it would appear likely that magnetic rocks underlie and accompany the basaltic obtrusion; so that the magnetic charts may be found capable of yielding valuable geological inferences. Another interesting fact is that some remarkable automatic magnetic records from the magnetic observatory at Cheltenham, Md., seem to indicate sudden disturbances of a magnetic, as distinguished from a seismic nature, about the times of the first and second eruptions of Mont Pelee in Martinique.

The Sleet Break-down of the Manhattan System.

The adage, "Great oaks from little acorns grow," received an illustration in New York last week, when the most important branch of the Metropolitan transportation system was crippled and a great proportion of the population seriously inconvenienced for several days by a thin film of ice forming on the third rail of the Manhattan elevated. Though the situation created was sufficiently serious owing to the personal inconvenience to up-town residents and the loss of time to busy men and their employes, it was recklessly exaggerated by the newspapers, some of which, with their accustomed sensationalism, announced that the electric system was demonstrated to be an ignominious failure, and that the steam locomotive was to be restored on the Manhattan.

It is now fully recognized that the urban transportation facilities of New York have become inadequate to handle properly the passenger traffic under normal conditions, and the breakdown of the Manhattan system last week gave a foretaste of what is in store for the New Yorker if a remedy be not soon found. The addition of the underground system will but mitigate the evil temporarily, as in a few years the increase of traffic will repeat the situation. The crippled electric service was supplemented by all of the locomotive power available, but as the schedule could not be maintained, the crush at the stations and in the cars was tremendous. To relieve somewhat the crisis, passengers were permitted to enter some of the cars through the windows when the aisles and platforms were jammed solid, and on one morning train an engine tender was seen crowded with passengers. The personal inconvenience to passengers became often actual suffering owing to the pressure of the crowds, and was always a lamentable spectacle of indecency as regards the opposite sex.

The trouble was brought on by a fall of sleet, which produced and maintained a thin insulating coating of ice on the conductor rail. When the film first began to form, the contact shoe was able to remove it partially, but in constantly slipping from the iron to the ice, the interruption of the current which followed in each case gave rise to great arcs. During this period the high structure

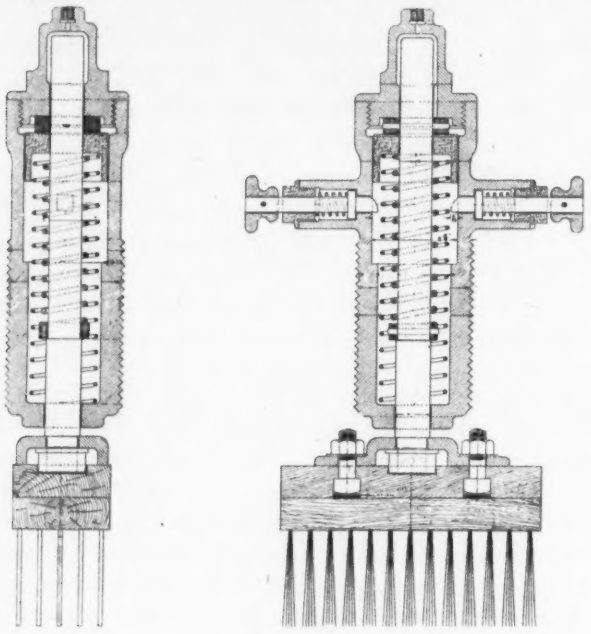


FIG. 1.—SECTIONS OF PNEUMATIC SLEET CLEANER.

at 110th Street became a scene of pyrotechnic display that brought crowds to the vicinity to observe. Finally, all electric cars were withdrawn. While difficulty from sleet had been foreseen by the Manhattan people, and brush and sprinkler equipments ordered to meet an emergency, it appears that there had been delay in delivery, and but few brush equipments were on hand. As soon as these arrived they were put in place, but it was then found that the remedy they were supposed to furnish was inadequate. Only part of the traffic on the Sixth Avenue line, where the worst trouble was experienced, was being handled by electric cars, and the intervals between these was not sufficiently small to enable the brushes to keep the rail clear of ice.

The accompanying illustrations show the contact shoe of a Manhattan motor car and one of the brush equipments. Each car is to be equipped with four brushes or scrapers, and as there are four motor cars to each six-car train, this will give 16 brushes per train. In order that they may be applied automatically, the brushes are mounted on a piston in an air cylinder, and by the opening of a single cock the motor can control all simultaneously.

Among other equipments that had been ordered by the Manhattan Company to meet the same emergency are ten oil and salt water spraying machines. These consist of tanks to hold oil or salt water, which is delivered in an atomized form through a nozzle located just above the contact rail.

The difficulty from sleet has been encountered on all the older third-rail elevated systems, and while at times it has resulted in some disorganization of the traffic, no situation approaching the recent one

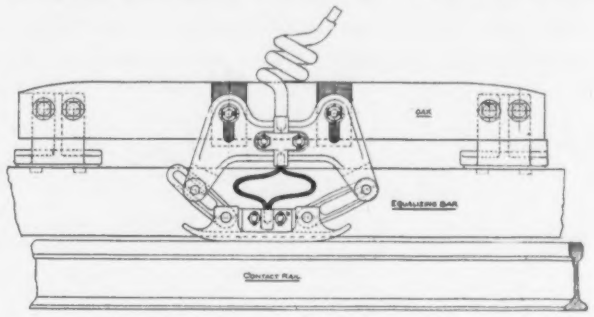


FIG. 2.—CONTACT SHOE AND HANGER.

in New York has developed. In Chicago, Boston and Brooklyn the cars are fitted with brushes, but main reliance against sleet appears to have been placed upon applications to the rail of oil in Chicago and Boston, and both oil and salt water in Brooklyn. It has also been found that if the rail is well oiled before ice has had a sufficient opportunity to form and adhere firmly, less difficulty is experienced in removing it with the brushes. In New York there appears to have been insufficient preparation for an emergency that was clearly foreseen, and lack of executive ability in meeting it when it arose.

It is fortunate that the capabilities of electric traction as applied to elevated railways had previously been thoroughly demonstrated in Chicago, Boston, Brooklyn, Liverpool, etc., as otherwise the recent experience in New York would have thoroughly discredited it. Owing to the shilly-shallying methods of the Manhattan in the past, and the extreme unpopularity of its management, the public has no confidence in its representations or competency; and if the fate of elevated electric traction had depended upon the Manhattan owners, these causes would probably "have held the art back for many years," to quote the language of one of the best-known transportation managers in the country.

International Congresses at the St. Louis World's Fair.

The president of the St. Louis World's Fair has announced the organization of World's Congresses, to be held in St. Louis during 1904. Howard J. Rogers, chief of the Department of Education, is to be the director of congresses. The Advisory Board to work in conjunction with him is as follows: Chairman, Nicholas Murray Butler, president of Columbia University, New York City; William R. Harper, president of the University of Chicago; R. H. Jesse, president of the University of Missouri; Henry S. Pritchett, president of the Massachusetts Institute of Technology, and Herbert B. Putnam, Librarian of Congress.

The duties of this Advisory Board will be more exacting than usually fall to the lot of advisory bodies. Upon their recommendations will be determined the number and extent of the congresses, the emphasis to be placed upon special features; the prominent men invited to participate, the character of the programmes, and the methods for successfully carrying out the enterprise. No effort will be spared to give the series of congresses at this exposition unity and connected purpose and make their published proceedings a valuable contribution to the world's literature.

A series of congresses has been an accompaniment of all recent international congresses, but they have always been disconnected, and rather incident to the exposition than related to it and supplementary to the exhibits. The work of the director and Advisory Board will be wholly given to constructing a co-ordinate department of the exposition which shall have an established scientific value and attract the attention of the practical scholars and experts of the world to St. Louis.

Ruhmer's Photoelectric Telephone.

BY A. FREDERICK COLLINS.

THE ingenious experiments conducted by Prof. Alexander Graham Bell having for their purpose the transmission of articulate speech by means of a ray of light, have been recently enlarged upon to a degree little short of marvelous by Herr Ernest Ruhmer, of Berlin. The two great fundamental principles involved in the Ruhmer electro-optical telephone—or photophone, as Bell termed his apparatus—are based on the phenomenon of resistivity variations of conditionally modified selenium under the action of luminous waves, and the changes in the light-emitting qualities of an arc under the influence of a superimposed current.

One of the earliest types of arc transmitter and selenium receiver is shown in Fig. 2, and was first employed by Prof. Bell. It represents a beam of light, either from the sun or an arc lamp—although the latter is the more preferable form—which is caused to pass through a condensing lens *a*, where the converged rays fall on a concave mirror *b* of small dimensions. This mirror is fastened with exactness, to the center of a diaphragm—such as is used in an ordinary telephone transmitter; and placed immediately back of it is a mouthpiece.

An objective lens *c* for projecting the light to a distant receiving device completes the transmitting system, and it is at once obvious that an electric current plays no part in the propagation of the message, if we except the fact that light is itself of electro-magnetic origin.

The receiver differs from the transmitter in that it is strictly an electro-optical apparatus. Referring again to Fig. 2, let *d* represent a parabolic reflector of short focal length and having in its focal line a selenium cell *e*. Connected to the terminals of the selenium cell and in series with it is a single element *f* and a telephone receiver *g*.

In action, the apparatus is quite simple. When the diaphragm of the transmitter is caused to vibrate, there is a relative change in the amount and intensity of the beam of light reflected from the mirror and through the lens *c*. The light waves, so propagated, are received by the parabolic reflector, and here again the diverging light is brought to a concentrated point of great intensity, where it acts upon the photo-electric cell of selenium which, with every minute variation of the converged pencil of light, responds by a similar change in its resistivity properties to an electric current.

With the object in view of developing the experimental photophone of Prof. Bell into a wireless telephone having an application which should be of commercial value, Mr. Ruhmer has devoted much time to the experimental investigation of the speaking arc, the selenium cell and their combination as forming a completed whole.

Shortly after Prof. Bell concluded his experiments with the photophone in this country, Dr. H. T. Simon devised the speaking arc, that is, he found that by superimposing an alternating current set up in a secondary circuit by an undulatory current of a primary winding including in its circuit an ordinary telephone transmitter—on a direct current operating an arc lamp, that the emitted light varied proportionately. These variations of the volume and intensity of the flame, although the persistency of vision removes the possibility of the eye discerning these changes, are sufficiently great to impress either a selenium cell or a sensitive photographic film, and it has been ascertained that these changes are due to the combined influence of temperature deviations of the arc and the quantity variations of the light produced by it.

FIG. 1.—RUHMER'S RECEIVING APPARATUS.

By causing a kinetoscopic film, such as is used in moving-picture machines, to move rapidly before the speaking arc, Ruhmer has succeeded in photographing these changes and in this way he obtained a continuous record of the different degrees of light representing articulate speech; and by passing this moving record of the voice before an arc light and a selenium cell in circuit with a telephone receiver the original sound waves are reproduced with very little distortion and with considerable distinctness, and thus a new form of phonograph results.

To employ the speaking arc and selenium cell for a wireless telephone, the combination Ruhmer has effected for long-distance

transmission is that of placing the arc in the focal line of a parabolic reflector, the reflected light taking the form of a parallel beam, and which may be directed to the distant receiver. The requirements for the production and reception of messages by means of the photo-electric telephone are numerous and depend quite as much on the transmitter as on the receiver. Among the more important factors of the former is the sensitiveness of the microphone, which determines the value of the undulatory alternating current which is to be superimposed upon the heavy direct current operating the arc lamp.

A transmitter of exceeding sensitiveness and requiring a minimum pressure, say six or eight volts, is quite superior to the less sensitive

FIG. 2.—BELL'S EARLIEST PHOTOPHONE.

one taking twenty-five volts. The nature of the arc must also be taken seriously into consideration and again the value of the luminosity best adapted to the sensitiveness of the selenium cell chosen; and after this the critical value of illumination must be carefully and constantly maintained if good results are expected.

Ruhmer has ascertained that for limited distances, say one or two kilometers, the results were best attained when 4 or 5 amperes of current under a pressure of 52 volts was used, but that for the transmitting speech over three or four kilometers, it was necessary to feed the arc with a current of 8 or 10 amperes, and if it was desired to increase this distance to five or seven kilometers a current of 12 to 16 amperes was the most suitable.

One might take it for granted on first thought that the larger the current consumed by the arc the better the results, but Ruhmer cites the following reason the values above given are best adapted which are based on Braun's investigation of the arc. In accordance with Joule's law, the heat developed is proportional to C^2r and the increase in heat produced by a greater current strength dC is proportional to $^2Cr\ dC$ and therefore C or the current operating the arc.

It has been demonstrated that a selenium cell is considerably less sensitive to the variations of an intense illumination than when the light falling upon it is of a certain minimum value; and as a heavy current increases the luminosity of the field, the greater volume of light obtained avails the tests nothing, either in the elimination of distortion or loudness of speech, but if anything the reverse is more often the case.

After having evolved the elements constituting the transmitting apparatus so that the obstacles a beam of light encounters in its propagation through space, due to the inherent atmospheric changes, might be overcome or obviated to some extent, Mr. Ruhmer next applied himself to the subject of receiving these infinitely minute wave lengths. After having followed the transition of the sender devised by Bell through its successive stages when perfected by Ruhmer, it is interesting to review the latter inventor's work in adapting the selenium cell to long-distance wireless telephony.

Like the coherer used in wireless telegraphy, the selenium cell in its recent state is constructed upon the same lines as those manufactured in their early history; that is, no radical change has taken place in the mode of making, but the development of each has been upon the basis of improvement rather than invention.

The evolution of the cell employed in the earliest form of the photophone, i. e., by forcing fused selenium between conducting wires forming a grid did not result in any marked increase of sensitiveness until it was developed by Ruhmer, who, in the course of his investigations, has tested many different selenium cells obtained from various sources. One made by the firm of Clausen and von Brouh, he considered particularly sensitive, a ratio of 10 to 1 having been established for it in resistivity changes, the maximum resulting from illumination and the minimum when obscured.

Another sensitive cell made by Giltay offered a resistance of 533,000 ohms in darkness, which under the decreasing action of 400 lux dropped to 26,000 ohms, but both the cells mentioned possess the disadvantage, according to Ruhmer, of having a high time constant in returning to their original resistance after the light is cut off. Added to this they do not operate well under the action of the shorter wave lengths of light, thus following closely the analogy presented by the metal filings coherer, for in both cases, after the drop in resistance has taken place, ten or twelve hours and sometimes a much longer period is required before the normally high resistivity is again reached.

Ruhmer therefore sought for some modification by which the resistance would reach its normally high value much more quickly—similar to a self-restoring coherer—and this he accomplished in the following manner. In the older forms of sensitive cells, the grid of conducting wires with its selenium filling was made flat, and when used with a parabolic reflector the converged light did not illuminate the cell uniformly. In order that the light might be distributed evenly over the entire surface of the cell, Ruhmer gives them a cylindrical form by duplexing two fine platinum wires wound parallel to each other on a glass tube 20 mm in diameter and 35 mm in length; the space between the wires is about 7/10 mm and the whole is then coated with the properly prepared selenium.

To prepare the selenium, it is necessary to melt the red powder, in which state it is primarily found, and apply the degree of heat needed to reduce it to a black, gummy mass when it becomes, virtually, an insulator.[1] It is in this condition that the amorphous selenium is applied to the platinum wires forming the cell when it is baked at a constant temperature of 200° F. for a period of twelve hours or longer; the next step is to anneal or gradually reduce the temperature when a crystallized form of the selenium results, having a characteristic gray color. It then assumes the most remarkable property of varying in resistivity under the action of light.

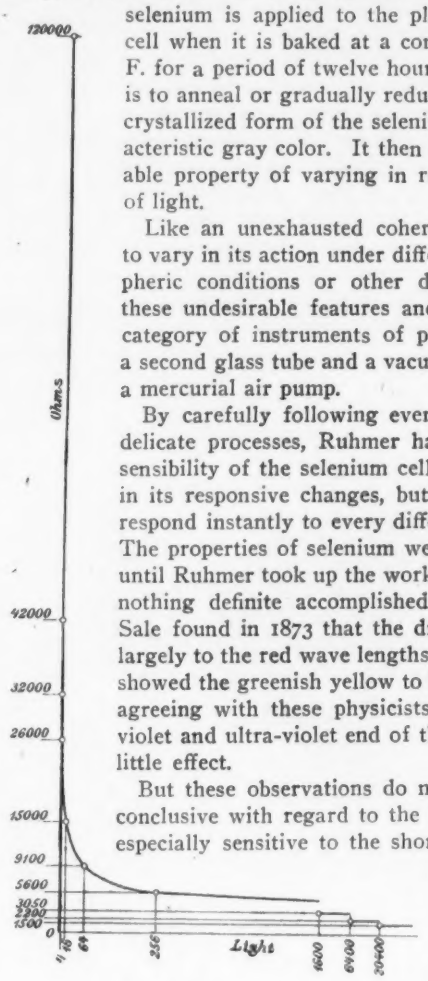


FIG. 3.—RESISTANCE CURVE.

Like an unexhausted coherer, a selenium cell is apt to vary in its action under different temperatures, atmospheric conditions or other disturbances. To exclude these undesirable features and to place the cell in the category of instruments of precision, it is enclosed in a second glass tube and a vacuum is formed by means of a mercurial air pump.

By carefully following every detail of the foregoing delicate processes, Ruhmer has not only increased the sensibility of the selenium cell and rendered it accurate in its responsive changes, but has obtained cells which respond instantly to every differentiation of light values. The properties of selenium were observed long ago, but until Ruhmer took up the work there seems to have been nothing definite accomplished recently. For instance, Sale found in 1873 that the drop of resistance was due largely to the red wave lengths, and Adams's observation showed the greenish yellow to be the most effectual, and, agreeing with these physicists, Dingler found that the violet and ultra-violet end of the spectrum produced but little effect.

But these observations do not appear, by any means, conclusive with regard to the Ruhmer cells, for his are especially sensitive to the shorter wave lengths, and in this they fulfill an important requirement for long-distance wireless telephony by the photo-electric method. For obtaining the resistance curve shown in Fig. 3, the receiving apparatus consists of a selenium cell arranged in the focal line of a parabolic reflector having an opening of 50 cm. The resistance of the cell in the dark was 120,000 ohms and when illuminated by a 16-cp lamp the resistance dropped to 1,500 ohms. The receiver proper is shown in the photograph, Fig. 1, and includes a pair of head telephone receivers wound to high resistance and having feeble magnets actuating very thin diaphragms.

The experiments were conducted by Ruhmer on the Wannsee and the Havel, a map of which is shown in Fig. 4. The arrows illustrate the direction in which transmission took place. The figures on the map correspond to the experiments in the order in which they were made. In every case, the transmitter was placed on the electric

[1] Das Selen und Seine Bedentung fur die Electrotechnik von Ernest Ruhmer. ELECTRICAL WORLD AND ENGINEER, November 15, 1902, p. 798.

launch *Germania*. The first trial was made across the Wannsee in the daytime, a distance of 1½ km, when the air was clear. The second experiment took place in a heavy rain. This was also across the Wannsee, the distance being 1.6 km. An accident to the storage battery prevented tests to a greater distance.

On July 16, in the afternoon, when the sun was shining, another test made and proved entirely successful, articulate speech being reproduced clearly a distance of 2.3 km. As these tests exceeded in range the limits of the Wannsee it was determined to test the photoelectrical telephone on the Havel, where a greater distance could be obtained.

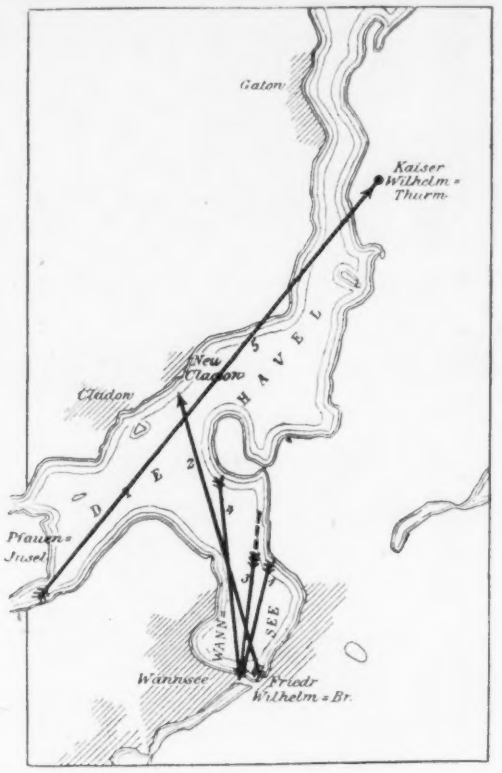


FIG. 4.—MAP SHOWING DIRECTION OF EXPERIMENTS.

On the evening of July 25 tests were made between the transmitter on the *Germania*, near Peacock Island, over a distance of 7 km, to the receiving station erected on an eminence at Kaiser Wilhelm Tower, Grunewald, and when the atmosphere was heavy and somewhat foggy. This ended the series of experiments, but I am informed by Herr Ruhmer that at subsequent tests he was enabled to transmit articulate speech a distance of 15 km, when it was received in a very satisfactory manner.

Some Notes on Illumination.

BY BASSETT JONES, JR.

WITH all the discussion that has lately arisen over the measurement of light considered primarily from the standpoint of artificial illumination, it seems proper that some note should be taken of the various methods of lighting required under certain specific conditions.

It is, of course, obvious that with widely varying requirements there must be widely varying types of illumination, and it will be found that there is a certain type of illuminant best suited to each condition. Possibly as lying at the two opposite extremes, may be mentioned the source of light best suited to illuminate the open air freight yard, and that best suited to illuminate the book for reading.

In the first case we require the widest possible distribution of light at maximum intensity, and in the second case the softest quality of light attainable, and projected preferably in a single direction.

There is little doubt that among existing types of illuminants the arc lamp is best suited to our first condition, while for the second condition we find the green shaded oil burner justly popular.

Under all conditions of illumination the object sought is so to arrange the light source that its rays are only perceptible to the observer through their reflection from illuminated objects. This result is impossible save in a few special cases, but the nearest approach to it will be secured by making the elevation of the source such that its rays do not shine directly or horizontally into the eyes, and this requirement applies equally to outdoor and indoor lighting.

Where the area to be illuminated is extensive the units of light should be so distributed as to give the most even illumination compatible with first cost, and maintenance of equipment. Bright spots, as well as dark zones, should be as far as possible eliminated, and where, as in the case of the arc lamp, the body of the fixture casts a shadow directly below, the arrangement of lights should be such that one lamp throws light directly under neighboring lamps.

The great difficulty with the arc lamp is that its maximum rays are inclined toward the horizontal, and this, while widening the area of illumination, produces decidedly uncomfortable effects on the eyes, and often by its very intensity prevents the observer from seeing the objects illuminated. This drawback has been in some measure illuminated by the use of the enclosed arc, using ground glass or diffusing globes, but even here the high intrinsic brilliancy necessary to an efficient illumination over a considerable area, still leaves the subject in an unsatisfactory stage of development.

Where enclosed arcs with clear globes are used, the marked unevenness of the illumination is decidedly detrimental. It may be overcome to some extent by bringing the lamps fairly close together, so that the portions of the surface left dark by one lamp may receive the maximum value of illumination due to a neighboring lamp. Except in certain special cases such an arrangement would produce an extremely wasteful brilliancy, and would be far too expensive for consideration.

The fact still remains that the arc lamp as at present used for outdoor illumination is unsatisfactory from every point of view, but until an ideal substitute is devised with its maximum intensity thrown at the widest angle and equally grading off to a vertical illumination suitable for the height at which the lamp is hung we must be satisfied to stumble along our streets in alternate brilliancy and darkness.

At present the tendency seems to be toward horizontal arcs, but here the vertical rays are the strongest, and diffused light must be obtained by the use of ground globes with consequent decrease of efficiency from the standpoint of light actually received. The flame arc appears to produce very satisfactory results and will doubtless become a hard competitor of the pencil arc, so soon as its complicated mechanism has been simplified.

By suspending the horizontal or flame arc at a considerable height it is possible to extend the radius of illumination, but only at the cost of intensity according to the laws of inverse squares.

As a rule, the value of the intensity of illumination is the first consideration only in outside lighting. In this case the maximum value of light that can be obtained and spread over a given area per unit of energy expended is the guiding factor. As we have mentioned, for the lighting of large areas from a few centres of illumination the vertical arc without doubt best satisfies the condition.

For street lighting, where the value of the light obtained is sufficient to warrant the use of numerous sources of light in fairly close proximity to one another, and where the traffic is sufficiently heavy, a source of light throwing its rays downward and at the same time diffused toward the horizontal, is much to be desired. Even if such a lamp does not show as high efficiency rated in mean spherical candle-power as is shown by the vertical arc lamp, its effective illuminating power—its value as an illuminant of the roadbed—will make its use advisable over all other forms of light source.

As a matter of fact, there are on the market to-day two or more lamps that satisfy these conditions in a greater or lesser degree, and have the advantage of efficiency nearly if not equal to that of the open arc. Unfortunately, they are still more or less in an experimental stage, although the Nernst lamp has, we may say, become an established fact, and has even been applied to street lighting.

On the other hand, for country roads, and in streets where the traffic is light and where the effective value of illumination is of small consequence, we are justified in using the lamp that will give the maximum intensity of illumination per unit of energy expended, and will spread its light over a maximum area. The quality of light emitted is now a minor consideration.

Thus, while a vertical arc lamp throws a dark spot directly beneath, yet the total area illuminated sufficiently for ordinary purposes is far greater than the lamp throwing its maximum intensity of light in a vertical direction.

When we consider interior illumination we find that the conditions vary in an infinite number of ways. Usually no actual formulæ are applicable for the very strong reason that the taste and needs of the occupants of the room or building vary in most extraordinary and unexpected forms. The success of the lighting system must depend practically entirely on the judgment of its designer and on his ability to see things through his client's eyes. Private house lighting is particularly variegated in this respect, and often a dozen different types of illumination are required within the four walls of one building.

In the lighting of halls and auditoriums and enclosed spaces of large extent, the same considerations that apply to outdoor illumination will, in a great measure, determine the system installed. Sometimes, sad to relate, first cost is the first consideration and consequently the light-giving source must be centralized.

Whatever the type of light adopted, it is imperative to supply the general light from a source overhead, and no light-giving sources should be permitted to throw rays directly into the users' eyes.

Wall brackets, for instance, should be used only for purposes of decoration—exceptions being taken in the case of bureau and dressing table lights. The light from wall brackets should be killed by the use of colored shades or globes. Table fixtures similarly should be supplied with colored shades that will reflect the light so as to confine it within the surface of a cone, no part of which reaches to the users' eyes.

From a decorative standpoint center chandeliers give the most effective "style" to room illumination. Even here the drop of the fixture should not be great enough to disturb the eyes with horizontal rays. The light units employed should be as far as possible small and numerous enough to give a hemispherical form of light source with the flat upwards. Design of fixture and quality of illumination may clash, but the result should tend along the lines indicated.

For the best quality of evenly diffused light single small power lamps studded in the ceiling give a most equally distributed illumination, but is to be criticised from the standpoint of light and shadow. A room without contrast is a most uninteresting and uncozy affair.

It is readily seen from the above considerations that in most cases the "watts per candle," or the mean spherical candlepower, has little to do with the value of the lamp as an illuminant. The principal factor in selection of the lamp is its suitability for the case considered. Circumstances are frequently arising where a number of low candle-power lamps are used in preference to a few units of higher light-giving power, although the former are more costly in both power and maintenance.

It seems peculiar that while an 8-cp lamp used frequently if necessary, will give so much better a type of illumination, yet all our energies have been expended in increasing the efficiency of the 16-cp lamp—a unit too powerful for all uses but that of general illumination.

Of course, it is the duty of the engineer to see that his client gets the most efficient lamp suited to his requirements, but the effective illumination desired must be the first consideration.

British Association in Africa.

An interesting event will take place in South Africa in 1905 which will definitely mark that country's progress and development. According to a recent London dispatch, the British Association for the Advancement of Science has accepted an invitation from the British South Africa Company to hold its annual meeting in 1905 at Victoria Falls, on the Zambesi River, where a hotel will be erected for the accommodation of the visitors. The company has appropriated $35,000 to meet the expenses. It is said that the only time the British Association ever held a meeting outside of England was in 1884, when it met in Canada. The sessions at McGill University, Montreal, will be recalled by many electrical engineers, especially as they were followed by the Electrical Exhibition and Electrical Congress at Philadelphia the same year.

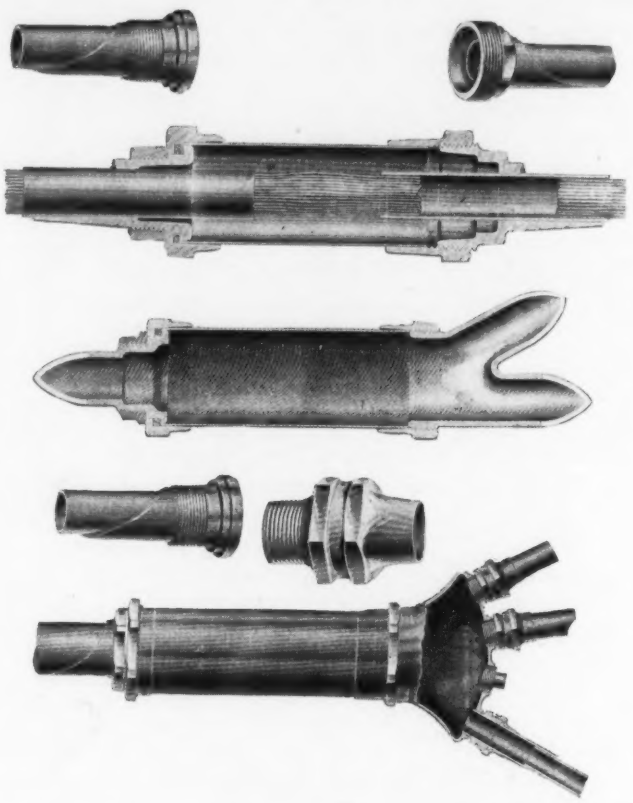
Telephone Cables—III.

By Arthur V. Abbott, C. E.

POT HEADS.

THE pot head method is so simple as to require little mention beyond the instructions to be found in the *"Cable Specifications,"* except to emphasize the absolute necessity of employing as insulating material on the terminal wires some non-fibrous material. Examined under the microscope all silk, cotton or other similar material is found to consist of an agglomeration of fibres, each of which is a little tube. No matter with what apparent care wires covered with such material be boiled in, or saturated with, insulating compound, it is found practically impossible to seal *all* of the multitude of little tubes that can serve to conduct moisture to the paper of the cable. For the pot head terminal wires there is nothing better than okonite,though this is expensive and inflammable.

Formerly the only method of splicing or pot-heading cable has been to make a "wiped" joint. If this operation is *well done* it is perfectly satisfactory, for thoroughly soldered surfaces are absolutely moisture proof, but wiped joints are difficult to make under the most favorable circumstances, while on the top of a 60-foot pole, with a kettle of melted lead for a companion, or on the swaying platform of a boatswain's chair, the probabilities of poor work are much increased. Further, a wiped joint requires skilled labor in the shape of a *plumber* with all the objectionable concomitants of that somewhat unsavory trade.



FIGS. 20, 21 AND 22.—TERMINALS AND METHODS OF MAKING JOINT SPLICES.

A method of making joints splices and terminals has recently been brought to notice, designed to avoid these difficulties, and further furnishes a method of making connections that possess the incalculable advantage of always being accessible to inspection. Figs. 20, 21 and 22 shows the plan adopted, and are self-explanatory. The illustrations exhibiting this method as applied to a straight splice in Fig. 20, a Y splice in Fig. 21, and a pot head in Fig. 22. In general this device employs a sleeve supplied with special threaded ends, designed to supply a moisture proof joint. To the sheath of each cable a similarly threaded piece of brass tube is soldered, and the splice or pot head completed by connecting the tubes with the sleeve by the screw joints. As all parts are interchangeable all soldering may be done on the ground and the ends boiled out, leaving merely the screwing up of the nuts to be performed aloft. This plan is

certainly sufficiently promising to be worthy a careful experience test to demonstrate its ability to cope with practical conditions. Unfortunately the expense of the joint (about 50 per cent more than the wiped joint) is likely to be a serious handicap.

THE INSTALLATION OF UNDERGROUND CABLES.

To install underground cable would seem a very simple process—simply pull each piece into its duct; but experience has indicated some desirable precautions. By means of the fish wire placed in the duct, as described under "Conduits," a strong yet soft and flexible manilla rope is hauled through the duct, and by its aid a brush and scraper is pulled through two or three times to clear away all accumulated debris. The plan of greasing the cable has been often tried, but with poor success, for while a lubricant may aid in drawing *in* the cable, its presence causes subsequent dust and dirt to so impact the cable that drawing *out* is difficult or impossible. The cable reel is placed adjacent to one manhole, and the pulling appliance at the next one. This may consist simply of an old-fashioned winch, worked by man or horse-power, but a far preferable, better and more economical device is a steam or gasoline motor geared to the reel one or more sheaves to guide the cable. With small sizes, when the sheaves can be made very large in proportion to the cable diameter, this is good practice, but with 2-inch or 2½-inch cable there is rarely enough room to work rollers of sufficient diameter,

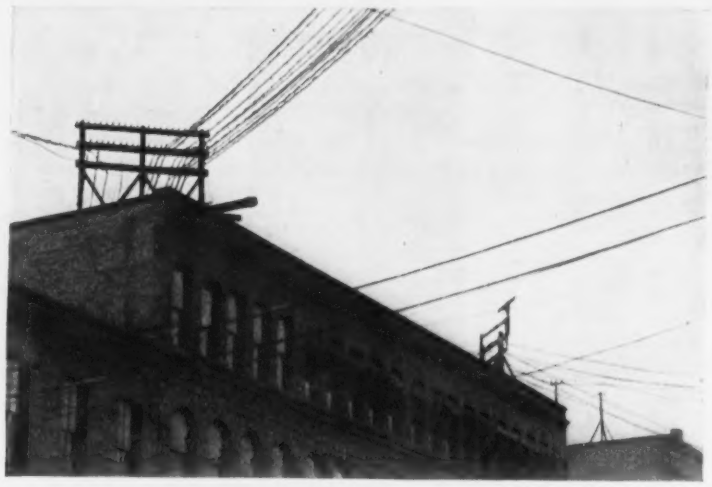


FIG. 24.—HOUSE-TOP FIXTURE.

and it is preferable to have a gang of men guide and feed the cable into the duct, the mouth of which should be protected by a conical shield of leather. As far as possible it is desirable to order cable of such lengths as can be drawn from point to point in the underground system. The various pieces are then supplied by the manufacturers with sealed ends, and there is little or no waste in cutting. Splicing follows next upon drawing in, and in case a length is cut from a reel, it should be either spliced, or the cut end sealed immediately, for even a few hours' exposure of an open end to the damp atmosphere of conduit vaults will injure cable insulation.

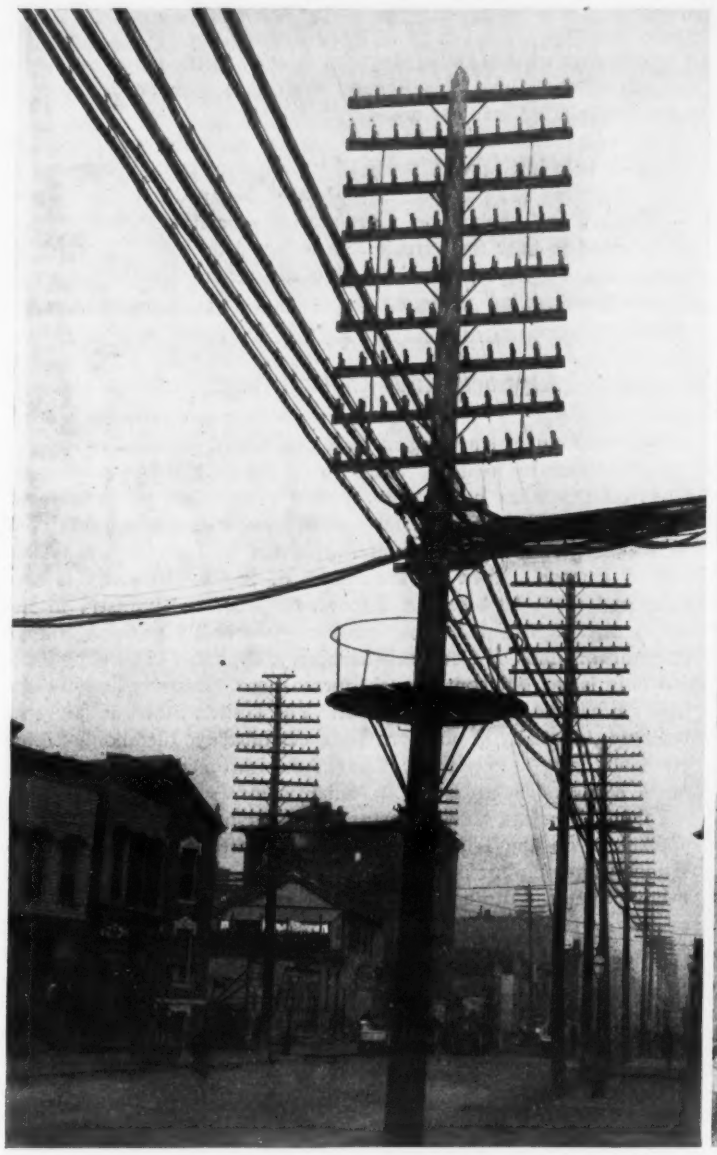


FIG. 23.—AERIAL CABLES.

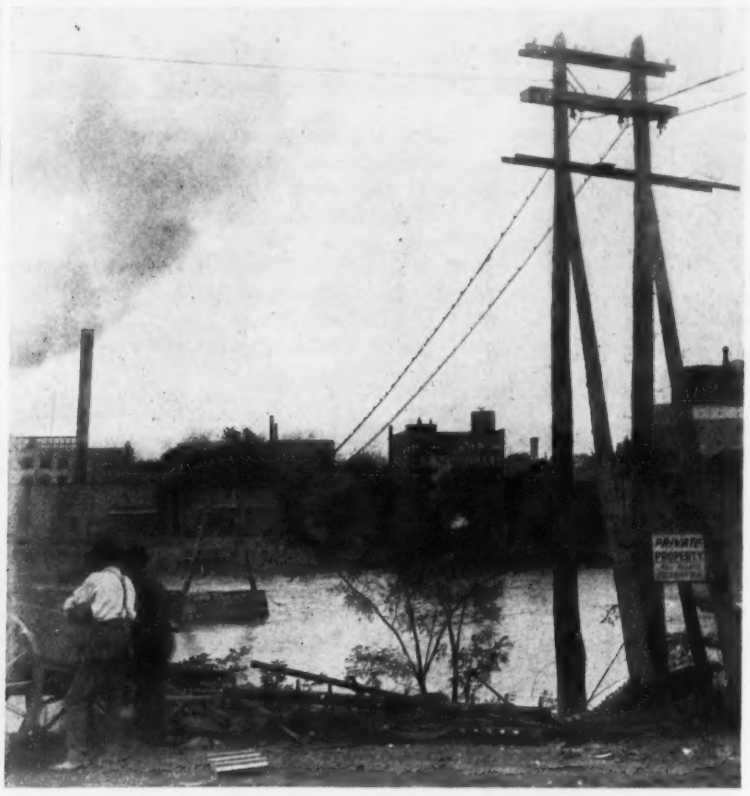


FIG. 25.—LONG SPAN OF AERIAL CABLES.

a small hoisting engine. The rope from the pulling machine, whatever it may be, is now attached to the cable, and here particular care is necessary, as the pull must be carefully distributed to the sheath. The best plan is to use a brass tube, a foot or more long, but slightly larger than the sheath to which it may be soldered. The end of the brass tube is supplied with an eye to which the rope is attached, and thus the pull distributed evenly to the entire lead. When all preparations are complete the drawing is started and should proceed slowly, steadily and uniformly without interruption till the desired manhole is reached. It is sometimes customary to place at

AERIAL CABLE.

The installation of underground cable is limited to drawing the cable into its duct. Aerial cable is suspended from pole lines; is necessarily placed in very diverse locations, and in far more exposed situations, hence the opportunity for "engineering" is much wider. Cable is far too frail to hang unsupported from pole to pole. It is customary therefore to run a wire rope ⅜ inch to ⅝ inch in di-

ameter called a "messenger wire" or "strand," to which the cable is at frequent intervals, as often as 18 inches to 2 feet, attached.

The strand is attached to the poles in case of an ordinary open wire line, as is indicated in Fig. 23, or to the rack of a house top

FIG. 26.—MESSENGER POLE SUPPORTS.

fixture, as in Fig. 24. By this method circuits may be carried over very long spans many hundreds of feet, as illustrated in Fig. 25, more cheaply and safely than by an other device.

When there are not more than two cables the strand is most con-

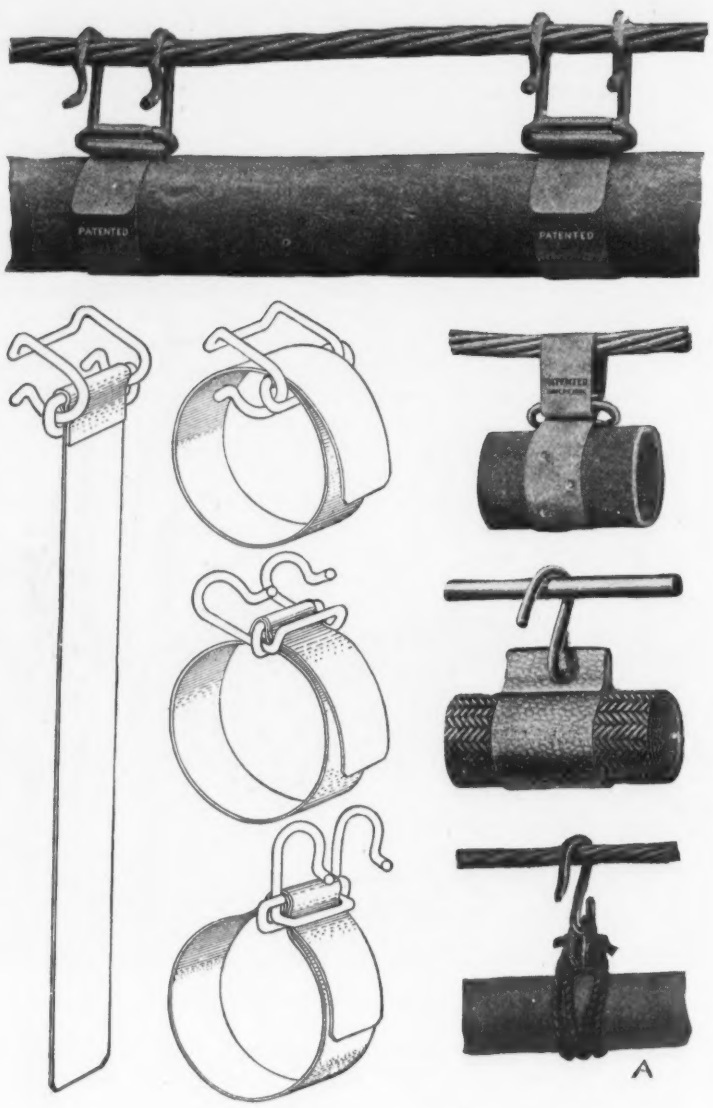


FIG. 27.—DIFFERENT STYLES OF CABLE HANGERS.

veniently supported by the method of Fig. 26, but if there are a greater number an angle iron cross-arm, bolted to the pole, is by far the best method, as is illustrated in Fig. 23. Hundreds of devices have been advanced for attaching cable to the messenger, a few of the more successful of which are shown in Fig. 27. The chief requisites are ease and cheapness of application; permanence, i. e., freedom from slipping or unhooking and no injurious action to the lead of the cable.

Few of the modern cable hangers meet these characteristics better than the old-fashioned marlin loop, shown at A, Fig. 27. Well-tarred marlin will last nearly as long as the cable. If the hook be closed there is little tendency for the cable to leave the strand; with each sway of the wind the slip nose hugs more tightly and rarely slips, and lastly this is one of the quickest and cheapest methods of application. Another plan of support is that of the "Spinning Jenny," as exhibited in Fig. 28. A split spool is clasped about both cable and strand, and then filled with marlin. When spool is hauled along, it lifts the cable close to the strand and lashes

FIG. 28.—CABLE-SPINNING JENNY.

it in place. Unfortunately, this plan is open to the objection that if the marlin gives way at any point the entire span is lost, and the cable precipitated into the street.

The weight of aerial cable is a very great addition to even the strongest pole line, and this form of wire plant should never be attempted unless the pole line be specially designed for the purpose. All corners and anchorages must receive special attention also and be designed to bear the extra stress inflected on them. For further details relating to cable construction the reader is referred to the "Cable Specification" to come later.

Opportunities in Italy and Sicily.

A correspondent traveling in Italy and Sicily writes us:

Italy, especially in its northern parts, abounds in powerful waterfalls; on the other hand, every pound of coal has to be imported, and, as a consequence, electricity is, in comparison with other continental countries, making greater progress in Italy than anywhere else in Europe. Even on the Island of Sicily, electricity is being more and more introduced. Though the electrical industry in Italy —I mean the manufacturing industry—is steadily growing, the imports of all kinds of electrical machinery, appliances and supplies are not only large, but continuously increasing. Germany and Switzerland get a good share of this trade. The United States is fairly represented, especially in northern Italy (Lombardy, Piedmont, Liguria, etc.), but there is very little, if any, American machinery to be found in the south of Italy, or on the Italian islands.

I think there is a good opportunity for the introduction of electrical appliances on the Island of Sicily for power, light and transportation. The sulphur mining industry offers an especially good field. I have visited quite a number of the principal mines and was surprised to see how electricity had made progress. There are, in Sicily, in the neighborhood of 650 sulphur mines, of which some 400 are being exploited. Of these 400 about 40 are worked by means of modern machinery, and these are, in the first place, the mines which offer a market for electrical enterprise. German and Swiss, and, to some extent, Austro-Hungarian firms, are doing a pretty good business in Sicily. When in Palermo I visited the Esposizione Agricola, where some space was devoted to agricultural and industrial machinery. The only American firms, represented with a few small exhibits, were the Enterprise Manufacturing Company, of Philadelphia; the Buffalo-Pittsburg Company, of Buffalo, and the McCormick Harvesting Company, of Chicago. Correspondence should be carried on in Italian or French; catalogues and all printed matter should be in either language. It would be waste of time to address these gentlemen in English.

Business in heavy machinery can be done direct with the mines, or by means of local agents. The latter are not easily to be found. German and Swiss manufacturers have their own offices in Italy. For the sale of small supplies for power, telephony, etc., electric novelties, lamps and so on, correspondence may be opened with Sicilian firms interested in such branches.

A French System of Train Lighting.

BY P. LETHEULE.

THE system of train lighting which has been patented and experimented on by the well-known French engineer, Mr. M. F. Loppé, in the shops of Daydé & Pillé, at Creil, may be considered, in its broadest aspect, as a general solution of the problem which consists in regulating the terminal voltage of a dynamo under very large limits of speed. In its application to train lighting it assumes the use of this dynamo combined with a storage battery employed as will be described further in the latter part of this article.

The principle of the method consists in providing the dynamo with two field windings. The first winding is excited by constant current of a given value. The second winding is connected in shunt between the terminals of the machine. The ampere-turns of the two field windings of this machine are in opposition, so that the resultant magnetization depends upon their respective values and on the way the dynamo builds up.

1. If the dynamo is first built up under separate excitation alone it gives a difference of potential across the shunt field terminals which excites these fields, but which can never overcome the first and opposed magnetization due to separate excitation. Thus, if we run the dynamo with increasing speeds, the difference of potential at the terminals increases slightly, thus increasing the ampere-turns on shunt excitation, and consequently tend to oppose a further increase of voltage with an increase of speed.

If the dynamo builds up as a shunt machine, that is, without its separate excitation, the difference in potential will increase at first proportionately to the speed. If at a given speed we connect up the separate excitation and send through it constant current from a separate source, so that its ampere-turns have a lower value than the shunt ampere-turns corresponding to that speed the difference in potential will decrease. If, however, we increase the speed of the machine its potential difference will gradually decrease towards a certain value. For an infinite speed it will have a certain limiting value, and increasing speeds will gradually bring the potential to this value with a variation which may be made unnoticeable.

Again, considering the first type of dynamo in respect to its use for train lighting, the shunt ampere-turns increasing with the speed of the machine have a limited value which is the value of the separate ampere-turns. That is, the difference of potential between the terminals is limited to the value corresponding to this limiting value of shunt ampere-turns which cannot be exceeded even with infinite speeds, though infinitely increasing speeds may tend to demagnetize the machine and to lead to some trouble at the commutator, a difficulty which will be dealt with in the results of tests.

Now that we have stated the limit of voltage of this machine, we can investigate the variations of its terminal voltage at different speeds in making use of the following notation and equations:

Let A_c = the value of independent ampere-turns, which is constant.

A_s = the value of ampere-turns of shunt excitation.

a-t = ampere-turns.

The corresponding terminal voltage E is related, to the value of ampere-turns A_s; to the exciting current i; to the number of turns n, and to the resistance of the shunt winding r,
By the equation

$$A_s = n\,i = n\,\frac{E}{r}$$

where $\frac{n}{r}$ has a constant value which may be denoted by a.

Thus, $A_s = a\,E$. We can denote the maximum value of E by E_M, corresponding to

$$A_c = A_s = a\,E_M$$

whence

$$E_M = \frac{A_c}{a} \quad (1)$$

For a given speed, corresponding to terminal voltage E_M, the shunt a-$t = a\,E_M$, and the separate a-$t = A_c$; the resultant a-$t = A_c - a\,E_m$.

These resultant a-t are proportional to the corresponding difference of potential

$$A_c - a\,E_m = b\,E_m \quad (1')$$

whence

$$E_m = \frac{A_c}{a+b} \quad (2)$$

Thus, from (1) and (2) we get the ratio between maximum and minimum voltage:

$$R = \frac{E_M}{E_m} = \frac{a+b}{a} \quad (3) \quad = 1 + \frac{b}{a}$$

The ideal regulation would mean equality between E_M and E_m, which correspond to the maximum and minimum speeds of the dynamo. This, of course, cannot be realized, but we can arrange for this ratio R not differing very much from unity, which is to say $\frac{b}{a}$ as small as possible, which can be obtained by a convenient choice of the dynamo constants A_c, n, r, i.

By investigating this condition it is easy to see that the number of excitation turns and the loss in excitation will be very large. In fact, if at minimum speed we express the proportionality of flux to difference of potential, we write again equation (1')

$$A_c - a\,E_m = b\,E_m.$$

The ampere-turns of the shunt excitation alone would show a much higher difference of potential:

$$E_{sm} = \frac{a}{b}\,E_m \quad (4) \text{ derived from } (1')$$

The independent excitation alone would give a still higher difference of potential E_{cm}:

$$E_{cm} = \left(1 + \frac{a}{b}\right) E_m \quad (5) \text{ derived from (1) and (1')}.$$

Taking for instance, certain conditions of regulation, we can easily see that they lead to a very wide range of excitation. Suppose we wish to keep a voltage not increasing more than 10 per cent., which is represented by $\frac{b}{a} = 0.10$.

Equations (4) and (5) show that

$$E_{sm} = 10\,E_m \quad (4')$$

$$E_{cm} = 11\,E_m \quad (5')$$

The ampere-turns of independent excitation have to be eleven times higher than the ampere-turns which would give the same difference of potential in working alone, and the shunt ampere-turns excitation have to be ten times greater than necessary.

We can, in a similar manner, calculate the ratio of ampere-turns of both excitations corresponding to different given values of regulation. We have expressed them in the following table, as ratios of their value to the value of ampere-turns giving the same voltage at the same speed, taking this latter voltage as unity:

Given values of $\frac{b}{a}$	0.10	0.15	0.20	0.33	0.50	1.00	2.00
A. T. shunt excitation	10.	6.7	5.	3.	2.	1.	0.50
A. T. separate excitation	11.	7.7	6.	4.	3.	2.	1.50

The practical applicability of the method has been tested by the inventor in the shops, Daydé & Pillé shops, with a dynamo which was not built for this special purpose. It was a bi-polar machine normally running with shunt excitation and at 1,500 r.p.m., giving 107 volts with 10 amperes load. The shunt coils were simply disconnected and one of them was used for shunt excitation, the other one being connected for separate excitation.

The following are the potential differences obtained at speeds varying from 2,000 to 3,000 r.p.m.:

Table I. Readings with load:

r.p.m.	Terminal voltage.
3,000	20
2,400	19
2,000	18

Table II. Without load:

r.p.m.	Terminal voltage.
3,000	22
2,600	21.5
2,300	21
2,000	20.4

In testing, the separate exciting current was maintained at the con-

stant value of 0.5 ampere. The maximum difference of potential corresponding to a shunt excitation current of 0.5 ampere, this with a resistance of shunt exciting field of 48 ohms, is:

$$48 \times \tfrac{1}{2} \text{ ampere} = 24 \text{ volts.}$$

No sparking could be noticed at the commutator and there was no necessity to shift the brushes, although the dynamo had not been specially built for the purpose of the trial. Under load the armature reaction and ohmic resistance of armature gave a drop of about 2 volts, so that the load difference of potential was about equal to $24 - 2 = 22$ volts.

This test, which was made for ascertaining the practicability, good running and safety of the system, seems conclusive, and points to satisfactory results.

It is always necessary to make use of storage batteries for lighting trains at stations. Moreover, as a dynamo has to be provided with

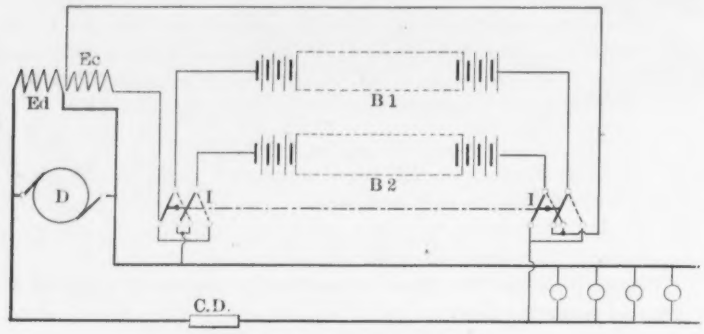


FIG. 1.—FIRST COMBINATION.

separate excitation, the separate exciting current may be obtained from a motor-generating set. Both of these arrangements have been patented by Mr. Loppé.

Three main dispositions of lighting are possible, which correspond to different conditions and cost. The first combination corresponds to the use of a battery for lighting and a second battery for separate excitation (Fig. 1).

The best disposition consists in taking two identical batteries which are interchangeable. A commutator can be used for changing over the batteries from one system to the other. This commutator is represented in *EE*. *CD* represents a maximum and minimum circuit-breaker which cuts off the dynamo when its electro-motive force is too low, and places it in circuit again whenever its terminal voltage is sufficient. When the terminal voltage is too low, the dynamo has one of its terminals disconnected from the corresponding terminal of the lighting circuit. This maximum and minimum circuit-breaker *CD* is therefore of the unipolar type, as seen from Fig. 1.

The second combination (Fig. 2) uses one battery only for lighting and a motor-generator set, *MG* for separate excitation. The motor *M* is shunt wound and connected to the terminals of the battery.

To assure a constant current in the separate excitation, it is necessary that the generator *G* shall produce a constant difference in

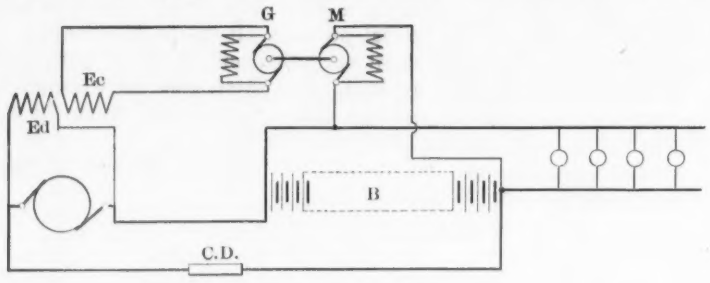


FIG. 2.—SECOND COMBINATION.

potential. As the variations at the terminals of the motor are small, the motor can be simply shunt-wound.

The third combination, Fig. 3, is suited to installations requiring a good regulation, even at the stations, where the battery takes the place of the generator.

Then the battery is discharging and the discharge voltage is lower than the charging voltage previously applied. The lamps are here disconnected from the battery for the purpose of avoiding the variation resulting from the difference between charging and discharge voltage of the battery. They are connected to the generator *G*, which permanently feeds the lamps and the constant excitation E_e. This gives a means of compounding the dynamo, if necessary, against any variations of output, or speed. For variation of output the generator excitation may be compounded.

For the slight variation in speed due to the variations in battery voltage, the motor *M* may be simply shunt-wound, but running in the straight part of its saturation curve; or it may even be compounded for assuring constant speed under variable voltage. With these dispositions it is necessary to build a special dynamo *D*, though the regulation need not be so close as in the preceding combinations. The regularity, measured by $\frac{b}{a}$, may be made much larger and quite sufficient, if the motor *M* is compounded, and the construction is therefore much less expensive.

Special dynamos of the same kind have previously been used by other inventors, but they all appear to have made use of a shunt dynamo with an opposed series winding. In Mr. Loppé's system

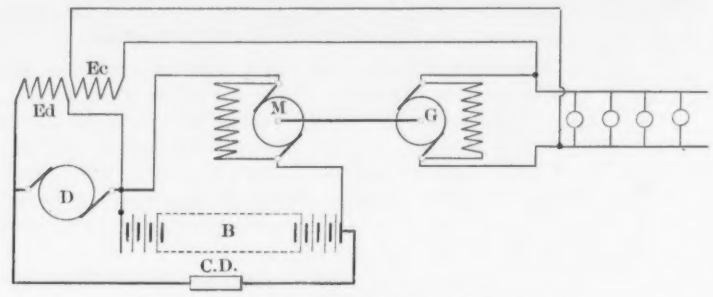


FIG. 3.—THIRD COMBINATION.

the separate winding produces the magnetization of the dynamo, against which is bucking a smaller opposite excitation from the shunt windings, a point much in favor of Mr. Loppé's system, as it leads to the use of a smaller battery. Indeed, in the other systems the series intensity increases with the speed, and the battery has to be of larger capacity, so as not to be deteriorated by the larger volume of current.

A Theory of Magnetism.

BY JOHANNES ZACHARIAS.

EIGHTY-TWO years have passed since Ampere published his theory of magnetism. During that time many widely different hypotheses have been formulated explaining the essence of electricity, yet to-day Ampere's theory is still the one most generally accepted. Most of us still incline to the explanation that a magnet is composed of molecules of steel, or in case of iron, of molecules of iron, which through the influence of the earth's magnetism, or of an electric current, become magnetized, so that two kinds of magnetism, positive and negative are present in each individual molecule. This influence causes the magnetic molecules to arrange or revolve themselves so that we have two resulting poles, as in a bar or horseshoe magnet, or others of like kind.

To the author it has been clear for many years (since the beginning of 1880) that this view and the duality of magnetism did not agree, and at a lecture delivered in February, 1882, he expressed the presumption that the magnetic phenomena are the result of pressure. This opinion resulted from the fact that the presence of pressure forces can be proved to exist everywhere in nature, as in the case of water, air and mechanical occurrences. Furthermore, philosophical reasoning has inclined the author to the opinion that gravitation, as in the case of weight, can only be due to pressure forces. Outside of magnetism and weight, the hypothetical attraction which we still ascribe to these two cannot be proved to exist anywhere in nature, and it is definitely known that a pressure is possible only because differences of pressure can be transmitted through any material or lever, so that all motion in nature is possible by this means only.

As a result of these reflections the author has come to the firm conviction that the origin of magnetism must be due to a pressure force. To prove this he has investigated during the past twenty years the magnetic properties of a straight electromagnet covered by means of an iron mantle or shell, one end of which was closed. The center of this magnet consisted of an iron core of the same length as the shell, while the space between the shell and magnet was occupied by a coil of copper wire. The author then studied the entire literature on the subject of the shell magnet and found that

the first construction of the same dated back to 1850 with the credit given to three inventors, Romerschausen, Guillemin and Fabre. The author immediately noticed that all writers on the subject claimed that a magnet of this description was bipolar. For instance, a recent writer, Prof. Silvanus Thompson, of London, on page 48 of his *"Der Electromagnet"* Halle, 1894, gives in Fig. 26 an illustration of a magnet of this kind and describes it as follows: "A magnet of the type as shown in Fig. 26 possesses at one end an inner pole, which is surrounded by a ringshaped pole of an opposite polarity."

If we compare this statement with another one made by Prof. Thompson, we will readily come to the opinion set up by the author. On page 26 of Prof. Thompson's *"Die Dynamoelektrischen Machinen,"* Halle, 1900, is as follows: "As long as we do not positively know what electricity is, so long will it be impossible for us to attain any definite knowledge regarding the nature of the current. But no electrician doubts this very important fact, that the magnetic forces which are present when a current passes through a wire are not present in the wire, but in the surrounding medium." The same almost is said by Prof. Thompson in the first English edition of his work, 1884, page 8. In these two quotations lies the whole point of the view and researches of the author. For, if the magnetic force has its origin outside of the electromagnet, *then in this case the origin must be due to pressure,* because even if the existence of the undemonstrable attraction is accepted, it will not hold, for the force is present not on the inside, but on the outside of it!

To prove the existence of this exterior force, the author studied the properties of the shell magnet very thoroughly, though by the employment of inexpensive and simple apparatus. The results of his investigations were published in the *Electrotechnischen Mitteilungen,* Halle, 1901. In the different papers published on this subject he shows not only all the different kinds of magnets and drawings of the different experiments as performed with them, but also five photographs are given, some taken in 1884, others in 1900 and 1901, which prove the absolute truth of these drawings.

In the course of the investigations it was learned that the sought-for pressure force increases disproportionately as soon as the straight electromagnet, as before described, is covered with an iron shell or mantle and supplied with an armature consisting of an iron cover so made as to close in the core and shell as tightly as possible. It is not the object to describe again all the experiments, and the author will simply briefly mention the most important phenomena to explain the questions here set up.

1. The shell magnet has at the open end, not as claimed in the literature on the subject, two poles, but is at this place unipolar, the upper rim of the shell showing no distinct pole.

2. The second pole of this shell magnet lies at the lower end and is so enclosed by the iron shell that it is very weak and has little external influence, and this starting from the lower end of the shell and continuing about half way up.

3. The investigation of the polarity could only be carried on by means of file dust figures, as a magnetized needle was not only unreliable, but showed two weak poles at the upper, open rimspace. These were no doubt due to the so-called earth magnetism.

4. By a suitable arrangement of the investigation it was proved that, when comparatively small holes were drilled in the base of the electromagnet, the force exerted on the armature would become disproportionately very small, although the so-called magnetic circuit between the core, shell and armature was not substantially decreased, these being still connected by a large amount of iron.

5. These facts can lead us to but one conclusion, that we are actually dealing with a pressure force as yet unknown, and till now thought non-existing.

From the above five statements we see the essence of electricity and of magnetism, not only in a totally different light, but one illuminating all the views regarding our observations of other natural occurrences up to the present time. The magnetic pressure on the magnet is dependent on the ether vacuum in the iron core (permeability), on the electrical energy in the coil winding, on the density of the ether in the bottom, in the shell and in the armature, as also on the area of the armature, and on the ether separation between the armature and the core and mantle; on the assumption, of course, that the essence of electricity depends on the ether.

The magnetism present in steel can be explained the same way. The same is dependent on the density of the material, on the cross-section of the material in reference to the pole area, and also on the electric currents flowing on the earth. In this case, as in that of the shell magnet, it is not very difficult to prove the existence of the pressure force.

This proof is dependent on the fact that we succeed in diminishing the pressure on the shell or steel magnet. The correctness of this conclusion is proved by means of well-known facts.

If we take two hemispheres, ground at the joints so that they are air tight (the so-called "Magdeburg Cups"), exhaust the air in them to about a quarter of an atmosphere pressure, hang them suitably so that they can be weighted till nearly the limit of their carrying power; if now they be placed in a suitable receptacle which can be exhausted to about a half atmosphere pressure, the weight suspended from the hemispheres will pull them apart, as the outside pressure can no longer support the lower hemisphere. The same result must follow if, as stated before, magnetism depends on pressure, and it is possible by means of suitable apparatus to reduce the pressure force around the magnet. Perhaps I may be accused of simply proving my theory by entering into a war of words and conceptions while the whole work is neither practical nor possesses a purpose. I am, however, almost ready to publish a nearly completed work showing the great extent of my discovery to the satisfaction of all; and that my discovery is not only of practical usefulness, but of great importance. I have positively proven that in the case of the shell magnet, two poles are *not* present at the upper end. I have also found (according to our present view) no completion of the circuit of the so-called lines of force on the upper part of the shell, although a magnetic circuit should exist. I have further proved that the shell increases the strength of the magnet 30 to 36 times that of a magnet without a shell. It has, therefore, been shown that considerable magnetic force is present, although the instrument is neither bipolar nor contains a magnetic circuit between shell and armature. Hence it can only be possible *that the magnetic force is a phenomenon due to pressure* and all our ideas and theories regarding magnetism must be newly stated.

If this presentation is overlooked, it might seem as if the above-discussed arguments must be evident to all. It required but one step and but one thought was necessary. By a system of logical reasoning we can arrive at the same result, yet in a way differing from that pursued by myself, namely by following the studies and investigations pertaining to the kinetic theory of gases, the wave motion and vibration of heat, light and electricity, etc. He who even then doubts that the magnetic force is nothing else than electric pressure, transmitted as wave motion, should recollect that not only have we determined the velocity and wave length of the different manifestations of energy, and we have ascertained the size of the active molecules, but that we have even measured them with accuracy. Wherever there is matter in motion, a force is present and work is done. The Röntgen rays prove this.

We know that light makes between 450 to 800 billion vibrations per second, the number depending on the color, and light is visible. Heat waves make about 500 billion vibrations per second and are not visible. The invisible electrical waves have even a larger number of vibrations, up to 80 thousand million, and we employ them in wireless telegraphy, or what perhaps would be more appropriate, wave telegraphy. Photography discloses to us the invisible ultra-violet rays, making 800 billion vibrations per second.

Between the viabrations of heat and electricity there is still an unknown sphere. And another beyond the hyperviolet waves. Much is still to be investigated.

We know that heat results in force and light does the same as is proven by Profs. Crookes and Lebedew. We no longer doubt that light, heat, electricity are due to the same kind of motion, and then should it be said that the electric waves do not result in pressure?

If, therefore, as has been done, we come to the same result by different methods, that the magnetic and likewise the electric forces are manifestations of pressure, we must conclude that this theory of pressure is not to be set aside, as has often been done before, but we must make further progress and advance it in all directions. This work of mine, therefore, deserves acceptance and claims appreciation.

I have also seriously considered whether I should attempt to oppose the existing opinions, deep grounded on scientific tradition, and openly proclaim that all thinkers and investigators since the year 1820, when Ampere announced his theory of magnetism, have erred. I am well aware of the responsibility that I assume in giving publicity to these statements.

The Production of Calcium and Strontium.

By H. Danneel.

IT is well known that the metal calcium, which in the electrical series and also as a reduction factor, occupies a position midway between aluminum and sodium, would be of immense value to the industrial world if it were less expensive. For reduction purposes when electrolysis cannot be employed and aluminum is too weak and sodium is too strong, sodium amalgam is used. The employment of this compound, however, has many disadvantages since organic mercury salts are easily formed and are difficult to remove. Furthermore, the use of calcium in organic chemistry would probably result in important scientific discoveries, if the price

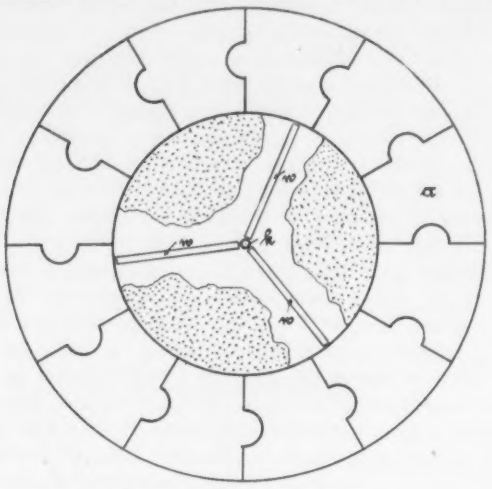


FIG. 1.—ELECTRIC FURNACE.

of the pure calcium were not too high even for scientific researches, being only recently 18,000 marks (about 4,500 dollars) per kgm. The metal would also be of great value in the iron industry. To remove phosphorus, sulphur and oxygen from iron, aluminum is used at present; but only a few tenths of a per cent. of aluminum remaining in the iron will spoil it. This danger is removed when calcium is used, because the latter does not become soluble in the iron. Whether the presence of traces of calcium will affect the iron is not known, but this can be ascertained very easily. In any event the calcium will act more energetically on the impurities of the iron than the aluminum.

It is, therefore, not to be wondered at that many inventors and

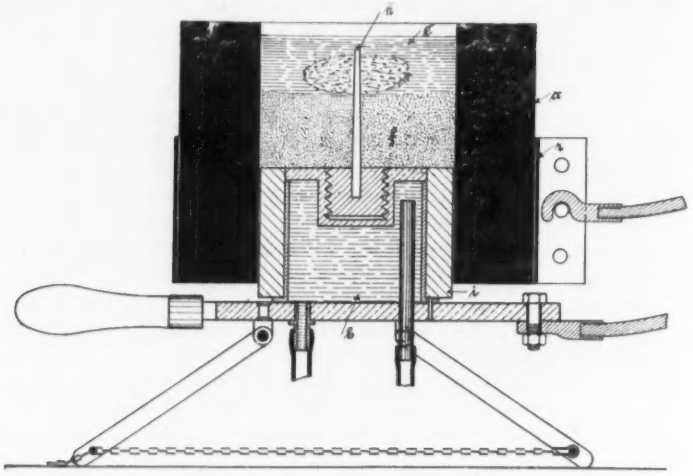


FIG. 2.—ELECTRIC FURNACE.

scientists have endeavored to produce calcium by a less expensive method. That attempts have been unsuccessful to accomplish this on a large scale is evidenced by the high price of the metal. Formerly calcium was obtained by electrolizing a diluted solution of the calcium chloride by using a mercury cathode and by liberating the mercury from the amalgam thus obtained by the application of heat. Aside from the fact that this method is complicated and, therefore, expensive, the calcium thus produced is never quite pure, as it always contains some mercury. Recently Moissan has obtained calcium from calcium iodide by electrolysis, but only very small quantities were produced in this way.

Prof. W. Borchers and Mr. L. Stockem have succeeded in constructing at the Institute for Electro-metallurgy at Aachen after many laborious and costly experiments, a furnace in which calcium can be easily produced from fused calcium chloride by means of electrolysis. If a small cathode and a large anode are used and the calcium chloride is brought to a slightly red heat, then the calcium collects at the cathode in the form of a spongy mass, which may be removed. If the mass is then dipped in petroleum, a spongy metal is obtained saturated with calcium chloride which contains, however, from 50 to 60 per cent. pure calcium. If the spongy mass is squeezed by means of tongs while it is still warm, the chloride flows out and a substance remains which contains 90 per cent. of the calcium metal. By excluding the air, the latter may be fused into a firm silvery white mass. By this process calcium may be produced for 3.60 m (90 cents) per kgm, or about 5,000 times as cheap as formerly. The apparatus shown herewith is constructed as follows:

The retort consists of a cylinder, *a*, composed of carbon rods joined together in stave fashion and held together by a metal ring, *r*. This cylinder forms the anode, and it is connected to the circuit by means of the ring, *r*. The cylinder is closed at the bottom by a cooler, *h*, which for simplicity also serves as the support of the cathode. The latter consists of an iron rod, *k*, placed in the center of the cooler, *h*. It is thus connected through the cooler to the negative pole. The cooler must, of course, be insulated from the anode by some fireproof material, such as the clay cylinder *i*, so as to prevent any leakage of the retort. A layer of fluorspar, *f*, is firmly packed on the bottom of it, which on account of its higher melting point, and on account of being cooled by the cooler *h*, generally remains solid during the operation of the device. Above this the fused mass of calcium chloride, *c*, is packed, and in order to start the fusion, the iron rod *K*, is connected with the carbon cylinder *a*, by several thin carbon rods, *w* which are embedded in the upper layer of calcium chloride, and through which the current is sent. The upper portion of the chloride thus begins to fuse, and by removing the carbon rods, *w*, at that time, the electrolysis is started.

By thus fusing the metal, there was obtained besides the pure metal, a red salt, probably CaCl. To obtain strontium was attended with more difficulty, because it separates in small fused spheres which easily rise to the surface and there re-unite with the anode chloride or escapes into the air. The apparatus, therefore, had to be so changed that the passing of a metal towards the anode was made more difficult. Strontium, like calcium, is a white metal as soft as lead. This apparatus was constructed as follows:

The cathode, an iron rod, was placed in the center of a large cooler only reaching into the cylinder to an extent that its upper end only

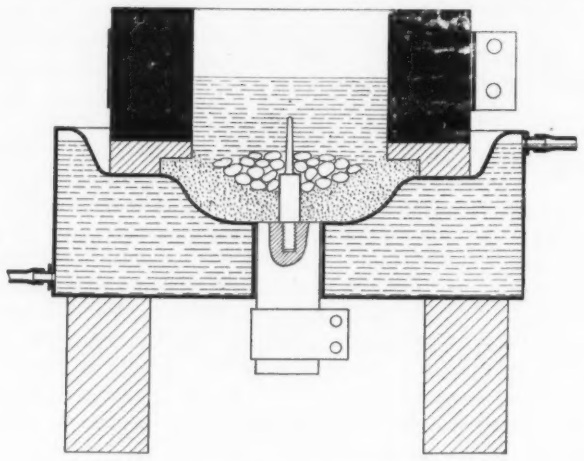


FIG. 3.—ELECTRIC FURNACE.

extended slightly above the lower surface of the carbon cylinder, which formed the anode. The other was supported, in order to insulate it from the cooler, in a ring of fireproof material, which in turn was placed on a recess in the cooler, as shown in the diagram. The diameter of the cooler was made larger than that of the carbon cylinder, so that during the operation of fusing a central depression was formed in the solid salt which constituted the bottom of the cylinder. The electrolytically liberated strontium settled in this hollow and was solidified from below due to the cooling. The strontium metal was found here, after the electrolytic action was stopped, in the form of spheres up to 1 cm in diameter.

The Armature Reaction of Alternators—VII.

BY C. F. GUILBERT.

PREDETERMINATION OF LOAD CHARACTERISTICS.

IN the previous article the general considerations relating to the predetermination of load characteristics were given, and the actual construction of such characteristics will now be taken up.

Assuming that Fig. 7 represents the armature characteristic (flux curve or curve of maximum useful induction) of an alternator, and let AB be the maximum useful flux corresponding to no-load and to a m.m.f., OA. If we accept the sinusoidal law with respect to the distribution of the transverse m.m.f. we can draw from the point A as a center a semi-circumference having a radius equal to the mean value of the transverse m.m.f. calculated by the preceding formula, and multiplied by $\frac{\pi}{2}$ in order to have the maximum of this mean value. The mean value is here considered with the object of simplifying the calculation of the transverse flux. Rigorously, the transverse reaction should be considered for various positions, for each of which should be found, as will be seen later, the values of transverse flux, which values can then be used to construct a curve of which the mean value will be that sought.

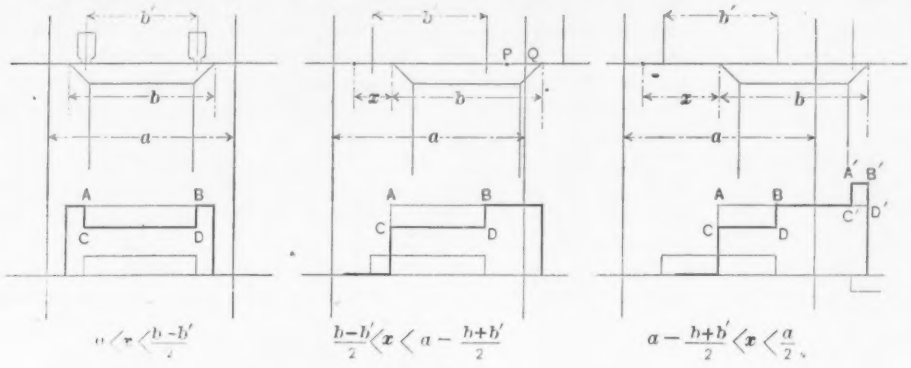


FIG. 1.

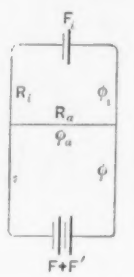


FIG. 2.

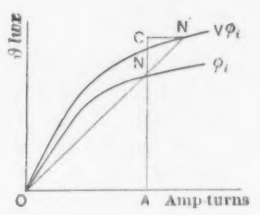


FIG. 3.

The semi-circumference corresponding to the center A can be regarded as representing the length of a polar step, and we can take off from each quarter of the circumference values equal to $\frac{b}{2}$. The m.m.f. in any point C of the polar arc is then obtained by dropping from that point a perpendicular such as OC' on OA. We then construct a curve of values of $C'F$ in function of the arc DC. If the intensity of the field in the gap were constant at no-load, as Picou assumes, this intensity would at load be represented by the curve HBF of Fig. 2. If this be not the case, it will be necessary to draw with BA as an axis and a maximum value, the curve representing the distribution of the flux, then take off points as F', F'', in such a manner that we will have $\frac{C\,F''}{C\,F'} = \frac{C\,F}{A\,B}$; or lower the points such as H', H'' with $\frac{I\,H''}{I\,H'} = \frac{I\,H}{A\,B}$ in order to have in $D''\,P\,B\,F\,D'$ the distribution of flux after distortion.

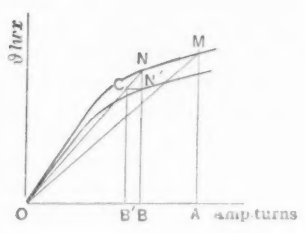


FIG. 6.

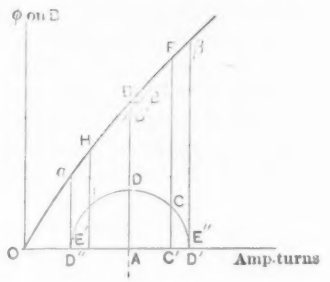


FIG. 7.

If this surface is not equal to the surface $D''\,P\,B\,Q\,D'$, but is smaller, the mean flux is reduced by the effect of the distortion, and to have its new maximum value it suffices, bearing in mind the ratio of the surface to its maximum ordinate, to drop the point B by the quantity $B\,B'$, such that the new surface representing the flux without distortion will be equal to the surface representing the flux after distortion.

The difference between the two parts to the left or the two parts to the right of the flux surfaces after distortion and without distortion but after reduction, will represent the transverse flux, which flux it is necessary to know for the calculation of the e.m.f. due to the transverse reaction. One can thus employ the curves of the points B', that is to say, the characteristic of undistorted the useful flux, to determine the number of ampere-turns $B\,B'$ (Fig. 1) necessary to be added to $O\,A$, in order to maintain the same useful flux after distortion. This curve is practically parallel to $\alpha\,\beta$.

It is to be remarked that if the portion $\alpha\,\beta$, of the armature characteristic is a right line, distortion will cause no loss of mean flux. This obvious property in the case of a homogeneous distribution of flux in the gap is also true for any distribution symmetrical with the axis of the pole, as can be verified easily, the point, B, then being a center of symmetry of the curve $\alpha\,\beta$.

The reduction of useful flux due to distortion and the transverse flux being known, there remains only a summary indication of the construction of the diagram for a given output, I, and the total phase angle ψ. For this purpose we can start from one of three points of view, as above implied, and according to the following assumptions:

1°. That the excitation be increased so as to maintain under load the same useful flux as at no-load.

2°. That the excitation be increased so as to maintain solely the flux constant in the field.

3°. That the excitation be simply assumed as constant.

Of these three alternatives the second (due to Picou) is the most convenient and necessitates the employment of partial characteristics

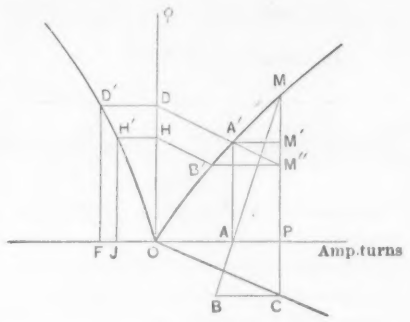


FIG. 9.

of the armature of the field and of the circuit or circuits of dispersion of the armature and field. With the first and third alternatives, the total no-load characteristic is alone necessary, and the increase of the m.m.f. $C\,N'$ (Fig. 3) in the first case or the calculation of the useful flux, $C\,B'$, in the second (Fig. 6) will determine, as has been indicated in the consideration of the value r and in connection with the formula giving the direct reaction.

To facilitate the application of the second method, we will first recall a very ingenious graphical construction for the loss of useful flux by the effect of direct reaction, also proposed by Picou. We have seen in the first part of this article that if the flux is main-

tained constant in the field, the direct reaction reduced the useful flux by the quantity $\frac{F_i}{R_i + R_a}$, while at the same time necessitating an increase of the inducing m.m.f. by the quantity $\frac{F_i}{v}$. To obtain graphically the reduction of flux, consider (Fig. 9) the armature characteristic. The useful flux, $M\ P$, produced in the armature by the magnetic difference of potential, $O\ P$, is evidently such that the tangent of the angle $M\ O\ P$ is equal to the permeance, $P_i = \frac{1}{R_i}$ of the armature. Trace below and from the point O a curve representing the values of the field leakage flux in function of the ampere-turns. For a magnetic difference of potential, $O\ P$, between the pole pieces, the lost flux will be $P\ C$. From the point C draw a horizontal line equal to the direct m.m.f, F_i, and join $B\ M$, which meets $O\ P$ at A. From A raise a perpendicular $A\ A'$ until it meets at A' the curve, and from A' draw a parallel line, $A'\ M''$, to the chord $Q\ C$. The reduction of the useful flux is $M'\ M''$, and the increase of the field m.m.f. to compensate for the transverse m.m.f. is $A\ P$. We thus have

$$A\ P = B\ C \times \frac{M\ P}{M\ C} = F_i \times \frac{\frac{1}{R_i}}{\frac{1}{R_i} + \frac{1}{R_a}} = \frac{F_i\ R_a}{R_i + R_a} = \frac{F_i}{v};$$

and $$M'\ M'' = A\ P \times \frac{1}{R_a} = \frac{F_i}{R_i + R_a}.$$

To take account of the field, it suffices to trace the characteristic of that part only of the magnetic circuit which is to the left; for the total flux to be developed being $C\ M''$, we have only to draw from M'' a line parallel to the chord, $O\ C$ to D, and then from this point a parallel to $O\ P$, to have at $D\ D'$ or $O\ F$ the m.m.f. necessary for the field. If we draw from M'' the parallel $M''\ B'$, and then from B' the parallel to $O\ C$ and finally from H the parallel, $H\ H'$ to $O\ P$, we see that to maintain a constant flux, $B\ M''$, in the armature at no-load and at load, it is necessary to increase the m.m.f.; first, by a quantity equal to $B\ M''$, then by a quantity $J\ F$, corresponding to the increase of field flux following the increase of dispersion. The sum $B\ M'' + J\ F$ is evidently equal to the value found above, $F_i \left(1 + \frac{r}{R_a}\right)$, increased by the ampere-turns corresponding to the variation of the reluctances r and R_i.

Independent Telephone Securities.

In a paper read before the meeting of the Interstate Independent Telephone Association, Mr. John W. Layne considered the subject of independent telephone securities. Capitalists of the East have been timid of independent telephone securities, by reason of being unable to comprehend the rapid growth and development of telephony in the Middle and Western States. Progress there has been much retarded for want of more capital for betterments, and to meet the increased demand for telephone service; hence the importance of better knowledge of telephone securities, and where to place them. His own experience, as well as information derived from other sources, led him to believe that the easiest way to float telephone securities is to enlist the aid of the local capitalists, using in this direction the same energy displayed in building up the business. By formulating a prospectus, showing both present and prospective financial conditions, surprisingly favorable results will be achieved. As an example of the value of such securities, the case of the Carthage, Mo., plant was cited, which has expanded from 220 subscribers to 2,250 in less than three and one-half years, and stock originally offered at par is now quoted at 300.

Recent Electrochemical Developments.

By Clinton Paul Townsend.

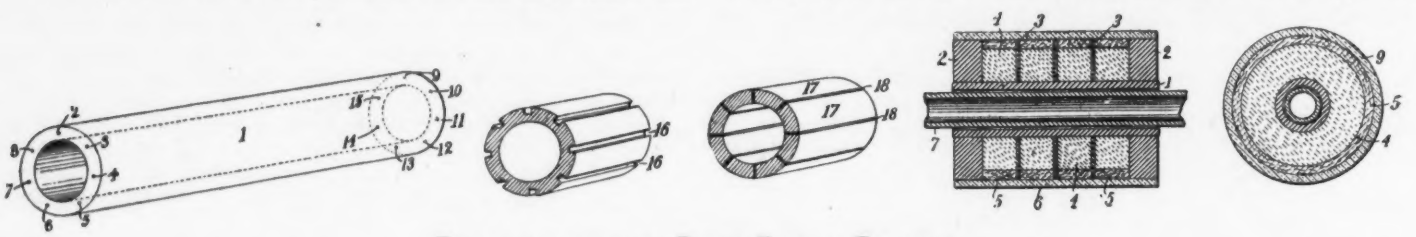
ELECTRIC FURNACES.

Mr. Henry Noel Potter, of New Rochelle, New York, has patented a number of electric furnace structures, all of the "tube" type, and all possessing features of especial novelty and interest. Mr. Potter's ingenious application of a non-fluxing and non-reacting jacket to furnaces of the Nernst type, depending upon the employment for a jacketing material of a single one of the mixed oxides which constitute the conducting body of the furnace, will be recalled. A jacket of this kind, being composed of a pure oxide, is substantially non-conductive; and being composed of the oxide which forms the chief constituent of the conductor, it is of course incapable of reacting therewith at any temperature at which the conductor itself is stable.

The present improvements are applicable either to Nernst furnaces, or to the older carbon tube type; they relate to means for securing an even heating effect in all parts of the tube; to the design of effective and permanent terminal connections; to constructions permitting free expansion of parts, both longitudinal and axial; to means for conserving the heat of the furnace; and to devices for strengthening the tubes and rendering such parts as are subject to wear readily replaceable.

Absolute uniformity, either physical or chemical, is scarcely to be expected either in the carbon tube or in one formed of dry electrolytes; hence an even distribution of the current, and an even heating effect, are seldom attained.

Figs. 1, 2, 3 show several forms of heating tube designed to equalize the heat effect. In Fig. 1 this is accomplished by the use of a plurality



Figs. 1, 2, 3, 4 and 5.—Potter Electric Furnaces.

of terminals, numbered from 2 to 15, arranged in opposed pairs, in conjunction with independent connections to the members of each pair; such connections may be from the separate secondaries of a transformer, or from ballast resistances in the several circuits from a common generator. Longitudinal partial divisions of the furnace tube, as shown at *16* in Fig. 2, effect the same result of restricting the current flow to definite paths; and the use of insulating or poorly conducting divisions *18* between conducting segments *17*, as in Fig. 3, is a further development of the same idea. From this construction to a conductor formed of a series of juxtaposed rods is but a step; this latter construction is, however, a part of the prior art.

Figs. 4, 5 show furnaces consisting of a carbon tube, *1*, carbon terminals, *2*, and a series of carbon collars, *3*; these collars surround the tube and prevent its distortion at high temperatures. The spaces between the collars are filled in with magnesia, *4*, and asbestos, *5*, and the whole is surrounded by tube *6*, which may be of glazed earthen ware. This furnace may be used with no parts other than above described, but it is preferred to provide an inner tube, *7*, which is rotatable and which may, if desired, be internally lined with magnesia. It is suggested that in this case the tube be made slightly tapering, in order that the magnesia lining may be slipped into place and adjusted in position to compensate for shrinkage.

Fig. 6 shows a device for mounting the tube to permit the furnace to be used in any position, and to allow for expansion of parts without interference with the electrical connections. In this construction *1* represents the carbon tube, *2*, carbon rings at either end, and *3*, *4*, metallic rings surrounding the carbon rings, *2*, and capable of being tightened by bolts, *5*, upon their beveled faces. These bolts, *5*, also secure the entire device to metal diaphragms, *6*, through which in turn the electrical connections to the external circuit, *10*, are made. A casing, *1*, and terminal plates, *8*, enclose the furnace, insulation, *9*, being interposed between the two. It will be seen that free longitudinal movement of the carbon tube is permitted by the elasticity of

the diaphragms, *6*, and that no change in dimensions or position will tend to reduce the efficiency of the electrical connections.

In 1889 Douglas Dixon suggested the following ingenious procedures for producing aluminum: Molten sodium chloride, rendered more fusible by the addition of sundry other alkaline chlorides, was electrolyzed, and the chlorine and sodium separately withdrawn. The chlorine was admitted to a chamber containing oxide of aluminum or this oxide admixed with carbon. Aluminum chloride was thereby formed, and being volatile at the temperature used, was brought into the presence of the metal sodium. Reduction occurred,

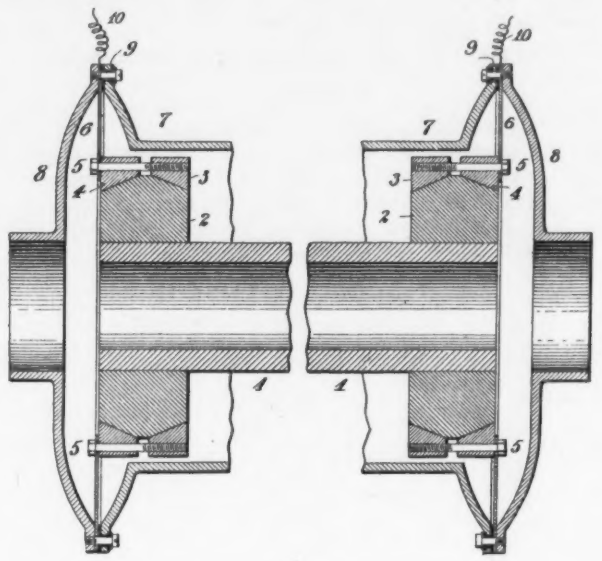


FIG. 6.—DETAIL OF ELECTRIC FURNACE.

the sodium chloride of the bath being regenerated, and the metal aluminum tapped off.

This period witnessed the rise of the Hall process, and it is needless to say that the method above noted did not enter the commercial field. It is curious to note, therefore, the recent issue of a patent to Giralamo Taddei, of Turin, Italy, for an apparatus designed for carrying into effect this very plan of operation. Taddei seems also to have developed the method quite independently, but it is highly improbable that better commercial success will attend the venture at this time.

Bids for Lighting Guayaquil.

Consul-General Thomas Nast transmitted from Guayaquil, November 12, 1902, just before his sudden death from yellow fever, translation of an advertisement by the municipal council, inviting tenders for lighting the city by gas or electricity. Mr. Nast said:

The tenders must be sent to the secretary, municipal council, of this city, not later than February 12, 1903, under sealed envelope. It is to be hoped that American capital will try to get the contract. The terms are:

1. The city to be lighted by gas or electric light, or by both, within limits provided for in the contract.

2. The lights to be located 3.5 meters (3.8 yards) above the surface and 1 meter (1.09 yards) from the houses' front (portales), and not be farther apart than 35 meters (38.1 yards).

3. Each light to be of 15.4 cp (international unit); at the intersection of the streets in the central part of the city, the lights to be of 80 cp, located at a height of 6 meters (6.5 yards).

In all cases, the lights used in the streets shall be arc lights.

4. The council guarantees that it will take at least 1,400 lights during eleven hours daily, also 50 lights of 80 cp—for which payment will be made monthly.

5. The municipal engineer and the inspectors of lights shall take the usual measures to test the quality of the lights in any part of the city.

6. The gas or electric conductors must be laid underground, and of the most modern system and size.

New Telephone Patents.

A few weeks since mention was made in these columns of a new type of insulator for telephone line wires by which the usual tie-wire was dispensed with. In the patent issue of December 9th a patent granted to Mr. Morton Harloe, of Hawley, Pa., describes another such insulator. In this insulator the usual petticoat, threaded hole and tie-wire groove are provided, but in addition three lugs project from the upper part of the insulator. Two of these lugs,

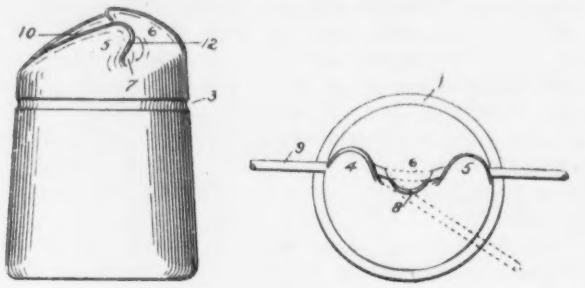


FIG. 1.—HARLOE INSULATOR.

shown at *4* and *5* respectively in Fig. 1, arise from the same side of the insulator and incline to the right. The third lug shown at *6* arises from the opposite side of the insulator and is so inclined as to overlap and pass between the points of the lugs *4* and *5*. The manner of using the insulator is self-evident, the aperture *7* being the resting place of the line wire. From the figure it will be noticed that the lug *5* is considerably lower than lugs *4* and *6*, which feature is one of the chief novelties of the invention, facilitating to a great extent the insertion of the wire.

The next telephone patent of this issue is one entitled "electromagnet." This patent describes a type of electrical relay wherein the adjustment for different current values in the operating coil is obtained by changing the position of the pole face of the core instead of changing the position of the armature, as has been heretofore customary. The advantage of this arrangement lies in the fact that a constant contact clearance is maintained irrespective of the relay adjustment. The manner of applying the invention is well shown in Fig. 2, which is a sectional view of a telephone relay embodying this type of adjustment. This relay is designed to break the contact

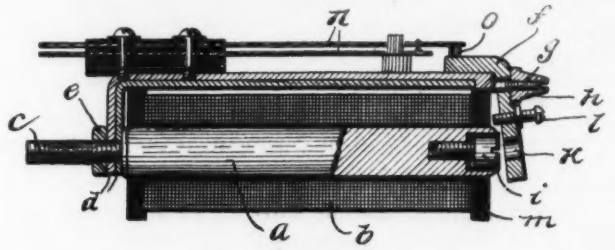


FIG. 2.—STROMBERG ELECTROMAGNET.

between two springs *n*, the upper of which follows the motion of the armature *f*. It is readily seen that any change in the position of the armature will affect both the normal and final positions of the upper contact spring, yet the air-gap, i. e., the distance between the pole face *i* and the armature *f*, must be varied to provide for the proper operation of the relay with different operating currents. This necessary adjustment of the air-gap is accomplished by recessing the core of the electromagnet and mounting therein an iron screw, the head of which serves as a pole face, and the position of which may be adjusted by a screw driver passed through the aperture *k* in the armature. Alfred Stromberg is the inventor of this device, the patent for which is assigned by him to the Stromberg-Carlson Company, of Chicago.

Again, the antiseptic mouthpiece is with us, but this time the attachment is purely mechanical, no chemicals being used. The new device is a holder for sheets of paper, and is applicable to all existing transmitters in such a manner that each user of the telephone may conveniently interpose a fresh sheet of paper between his mouth and that of the transmitter. Thus he is screened from infection within the transmitter and from infection from all other users. This attachment is the invention of Henry Baething, of Buffalo, N. Y.

A "Composite System of Electrical Transmission" is the subject

of patent 715,537, granted to Prof. Frederic Bedell, of Ithaca, N. Y. In this system Prof. Bedell proposes to use electrical lines for the simultaneous transmission of constant potential "commercial" currents and of signalling currents. Under commercial currents may be included all currents both alternating and direct, adaptable for light and power work; and by signal currents is meant telegraph, telephone and both alternating and direct-current electric bell currents. Prof. Bedell states that he finds he must provide means for attaching the signal circuit to the constant-potential circuit in such a manner that the point of attachment will at all times be at equal potential, this not the potential as measured by a voltmeter, but the instantaneous values of potential. Thus the points of attachment of the receiving and transmitting stations for the signalling current must be so located that change of potential along the commercial line will produce equal effects upon them. Further, they must be so arranged that their changes of potential will be simultaneous. In other words, the potential changes of the two points must follow the same wave forms, these waves being exactly in phase.

The principle of the application of the signalling currents to commercial lines will be readily understood by those familiar with central energy systems of telephony, by a glance at Fig. 3. Here *A* represents a two-phase power line feeding one phase to circuit *ab* and the other to circuit *a'b'*. These circuits are feeding lamps at *j* and *j'* and an electric motor at *Jx*. Again, *B* is a direct-current source feeding the line *cd*. The double circle *U* may represent one telephone station, while v^1 v^2 and v^3 represent others upon the same circuit.

By means of the various devices shown, i. e., the split and accurately balanced impedance coils, resistance coils and the balanced

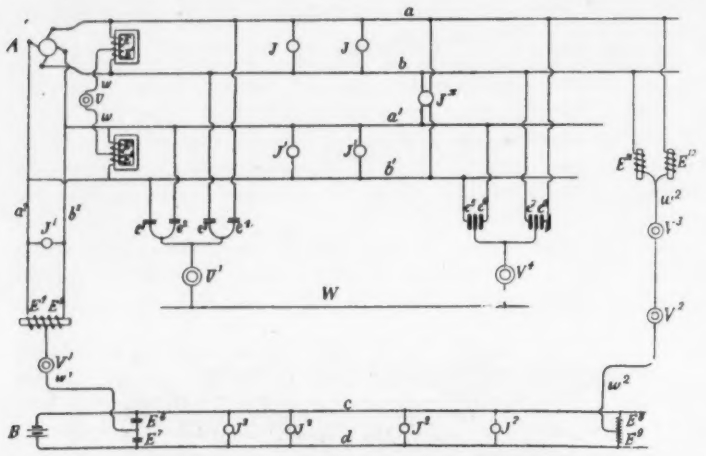


FIG. 3.—BEDELL SYSTEM OF COMPOSITE TRANSMISSION.

condensers, *E* E^1, E^2 E^3,—E^8 E^9, the signal circuit is attached to the constant-potential circuit; the line wires *ab*, *cd* and *a'b'* in pairs, in parallel, and in that order, serving as the signal current conductor. Again, a second signal circuit may be maintained connecting the instruments *U'* *V''*, for which circuit the wire *W* is a return, while the line wires *aba'b'* are used in parallel. Prof. Bedell also illustrates means for attachment to many other kinds of commercial circuits. He also describes means whereby such dangerous currents as would arise in the signal circuits through grounding or other accident to the transmission line, will be shunted around the signal instruments. For example, where the commercial current is alternating, and the signalling telephonic, a shunt, resonant to the power current but practically of infinite resistance to the telephone current, may be arranged around the telephone apparatus.

The inventor certainly appreciates the present-day difficulties of accurate balancing of impeding devices, but suggests that methods will be forthcoming which will solve this heretofore insurmountable difficulty. The practical telephone engineer, will, however, certainly have his doubts. Some of the claims of this patent are very broad, one in particular being so constructed that if taken literally it apparently covers all existing systems of composition for the simultaneous transmission of telegraphic and telephonic signals.

The fifth and last telephone patent of the issue under discussion, related to an improvement in magneto bells. This improvement has three distinct features: First, the simplification of the armature adjustment; second, increasing the resilience of the hammer rod; and, third, the provision of an adjustment such that each blow of the hammer will have the maximum effect upon the gongs. The first of these is accomplished by rendering the armature-supporting plate flexible, and making all adjustment from one end, the other end being held permanently in position. The change in the hammer rod consists in forming in it a double spiral, the plane of the spiral coinciding with the plane of motion. Finally the adjustment of the hammer is effected by interposing a socket between the hammer rod and the armature within which socket the rod is longitudinally adjustable. This patent bears the number 715,683, and the improvements are the invention of W. E. McCormick, who assigns his rights to the International Telephone Manufacturing Company, of Chicago.

Changes in the National Electric Code.

In regard to proposed restrictive action on high-voltage circuits by insurance interests, we quote the following official report from the bulletin of the American Institute of Electrical Engineers as to the proceedings of its committee on National Electric Code, of which Messrs. Kennelly, Ferguson, Gossler, Perrine, Steinmetz, A. Williams and Woodbury are members. This committee, which has had repeated conferences with a committee of the Underwriters' National Electric Association for the purpose of formulating rules respecting extra high pressure lines says:

A joint report was prepared which was considered by the Board of Directors of the Institute at a special meeting called for that purpose on December 8th. The following resolutions were adopted:

Whereas, the American Institute of Electrical Engineers has used its best endeavors through its special committee to bring about a satisfactory understanding in regard to the formulation of rules for the regulation of the location and construction of "Extra High Pressure Constant Potential Overhead Lines," and

Whereas, its committee has in conference with the Special Committee of the Underwriters' National Electric Association considered certain rules for insertion in the National Electric Code; and

Whereas, it has come to the knowledge of the Board of Directors of the American Institute of Electrical Engineers that various electrical interests are opposed to the acceptance of said rules in their present form; and

Whereas, there has been insufficient time since the receipt of these rules in their present form to have them fully and adequately considered by its membership; and

Whereas, the Board of Directors has received telegrams and letters to-day from various prominent members and committees of affiliated electrical societies bringing forward new evidence and urging that official action on these rules be deferred until they shall have had an opportunity to present to the board their views and arguments, therefore, be it

Resolved, That the American Institute of Electrical Engineers, through its Board of Directors, withhold for the present any endorsement whatever of the proposed rules for insertion in the National Electric Code.

Resolved, That the president of the Institute be authorized to request the postponement of official action by the National Board of Underwriters on this matter until the American Institute of Electrical Engineers has been enabled to consider through its membership the new and important questions now raised in connection with the proposed rules.

On December 9th the president of the Institute and the chairman of the Committee on National Electric Code, appeared before the Underwriters' National Electric Association and presented the resolutions with an explanation of the position of the Institute. Upon motion of Mr. C. M. Goddard, chairman of the Conference Committee and secretary of the Underwriters' National Electric Association, that body acquiesced in the position taken by the Institute.

Telegraphic Facilities at Coronation Durbar.

A special dispatch from Calcutta gives some interesting details of the preparations being made at Delhi for the coronation durbar, which is to be held on January 1 next. The interest that is being taken in the great event is evident from the fact that a special telegraph office has been fitted up to accommodate 200 operators. There will be thirty emergency wires, with a working capacity of approximately 1,000,000 words per day.

Telephone Law in Ohio.

Mr. W. F. Lanbach, of the Akron, Ohio, Peoples' Telephone Company, read a paper at the recent Interstate Telephone Convention which gave an account of some of the legal restrictions imposed in Ohio on the telephone business. A case was cited where an Ohio court decided that a telephone company whose franchise had expired could not be ousted for declining to assent to an illegal condition embodied by a municipality in a proposed new franchise. After quoting Ohio statutes on the subject of right of way, Mr. Lanbach said that they would appear to accord telephone companies unlimited rights upon country roads so long as wires were sufficiently high to clear a load of hay, and the poles sufficiently removed from the wagon track. But it has been decided that the abutting property owner retains a right over the same; that a steam or electric road has rights paramount to a telephone company; and that every grant in derogation of the right of the public in the free and unobstructed use of the streets, or restrictive of the control of the proper agencies of the municipal bodies over them, or of the legitimate exercise of their powers in the public interest, will be construed strictly against the grantee and liberally in favor of the public and never extended beyond its expressed terms when not indispensable to give effect to the grant.

It was pointed out that in Ohio there are restrictions concerning the handling of messages. A telephone or telegraph company is required to receive messages from and for other lines, and from and for any individual; and on payment of its usual charges for transmitting dispatches, as established by the rules and regulations of the company, it shall transmit the same with impartiality and good faith, under a penalty of $100 for each case of neglect, or refusal so to do, to be recovered with cost of suit, by civil action, of the company forwarding or desiring to send the dispatch. Another law is that "When the person who sends a dispatch desires to have it forwarded over the lines of other companies, whose termini are respectively within the limits of the usual delivery of such companies, to the place of final destination and tenders to the first company the amount of the usual charges for the dispatch to the place of final delivery, the company shall receive the same and, without delaying the dispatch, shall pay to the succeeding line the necessary charges for the remaining distance; and the succeeding line shall accept the same and forward the dispatch in the same manner, as if the sender had applied to it in person and pay the usual charges; and for the omission so to do it shall be liable to take penalty, as provided above."

Mr. Lanbach referred to the recent Ohio law taxing telephone companies at the rate of one per cent. of their gross receipts. The gross receipts are defined as "the entire gross receipts (including all sums earned or charged, whether actually received or not) for the year then next preceding the first day of May, from whatever source derived, whether message, telephone tolls, rentals, or otherwise, for business done within this State of each office within this State (giving the name of the office) and the total gross receipts of the company for such period in Ohio from business done within Ohio."

Pro and Con of Interurban Trolleys.

In a recent issue of the *Wall Street Journal,* the financial possibilities of interurban trolley systems are discussed pessimistically as follows by Mr. A. A. Lisman, of Lisman, Lorge & Co.: "I call your attention to the following striking facts on the continuous flotation of interurban street railways, and the extravagant claims made on behalf of projects of this character.

"The average cost per mile of interurban traction, especially when the road proposes to do a freight business, is at least $18,000. Adding thereto the contractors' profit makes the minimum cost per mile of road $20,000. In order to raise this money, roads are generally bonded for $25,000 in 5 per cent. bonds. In other words, the fixed charges per mile of road are $1,250. To this must be added at least $150 a mile for taxes and legal expenses, not counting damage suits.

"Taking the New York street railway report as a guide it will be seen that the average earnings per mile of interurban traction are $3,400, and the average operating expenses are 55 per cent., which is very low. This equals $1,870. Add to this maintenance of way and rolling stock, and above all, maintenance of electrical equipment, say only $1,000 a mile (certainly ultra-conservative) for a term of say ten years. All projects of this kind in the State of New York show net earnings of not exceeding $530 a mile less taxes, as above, $380, against fixed charges of minimum $1,250.

"These figures are taken from official records and the only change made is the addition of very limited charges for maintenance of way, power and equipment. Only by leaving the latter charge out can interest be earned. As a matter of fact, therefore, the average interurban road from its very inception when charged with essential expenses for renewal of maintenance, shows a deficit of $800 a mile. Of course there can only be one end to this kind of thing. The next reorganization period this country will see will be the reorganization of interurban traction properties, and from all indications this period is apt to come even more quickly in traction properties than it will come in industrials."

To this, however, Mr. Alfred M. Lamar make a very interesting reply, in the course of which he says: "The facts as stated and reason given for foreclosures and reorganizations, it appears, are confined to the State of New York, and the experience of the roads confined to that limited territory. It is a well-known fact that New York is one of the most undesirable States in the Union in which to build this class of roads, and except in specially favored localities they should not be built.

"The statement that the gross receipts of interurbans in New York State amount to $3,400 per mile is doubtless correct, but it is a fact that the gross revenue of such completed roads in the States of Ohio and Indiana are now averaging $4,975 per mile per annum. Taking the New York average of $3,400 per mile, he charges 55 per cent., of $1,870 for cost of operating, $150 for taxes and attorneys' fees, $1,250 interest charge and $1,000 per mile 'for maintenance of way, rolling stock, and, above all, maintenance of electrical equipment.' A total of $4,270, or $800 above gross receipts. The cost of operating placed at 55 per cent., is ample, as there are many roads being operated for a much less figure, and this includes maintenance of every kind. So even in New York, the future of interurban electric roads is not as discouraging as he would have it appear.

"Heavy freight business is yet in its experimental stage, and clear-headed traction men are not now insisting upon undertaking that branch of the steam railroads' business. The package or express business has proven very profitable and the frequency of trains will cause this business to continually increase, though there are isolated cases where the conditions are such that it is manifestly plain that heavy freight business will pay handsomely. Of course, there will be in this business instances where unwise methods and plans of financing prevail to wreck the business, but where conservatively financed, substantially built, and judiciously managed, there is no class of investment to-day in America that promises a safer and more substantial return."

How to Deal With City Congestion.

Whether London or New York is the worst example of a city choked by its own traffic is, remarks the *New York World,* an open question. Whatever gives relief to the general condition of cram and jam of either metropolis is consequently of first-class interest to the other. London's fearfully congested state, in the opinion of the *Spectator,* can only be remedied by these radical reforms:

All wires and pipes must be sunk in tunnels into which workmen can go and work without interfering with overhead traffic.

All goods must be received and discharged from warehouses and shops either before or after the hours when street traffic is at full tide.

All heavy hauling must be done in motor cars of large size, and the horse as a draught animal must be banished from the streets.

Pedestrians on the streets must be greatly reduced in number not only by underground railroads, but by spacious subways connecting one central point in the city with another.

These are obviously the main lines along which New York no less than London must seek to make the tension of daily life less severe and the toils of locomotion less arduous. It is simply inconceivable that we shall forever go on enduring the horrors of bridge "crushes," L road and surface car sardine-packing, sidewalks made impassable by barricades of merchandise, and crossings that are only to be crossed at the peril of life and limb.

Letter Boxes on Trolley Cars.

It is prophesied in Washington that Postmaster-General Payne is not going to have plain sailing with his experiment of placing letter boxes on the sides of street cars in cities, so that any one having a letter to post where haste in forwarding is important, can push it through a slot on the first street car he sees going toward the post office or the railway station. On every side it is admitted that the plan will add greatly to the convenience of the letter-writing public, especially in those districts in large cities where collections are comparatively infrequent. It would also reduce materially the work of the carrier force in every city post office.

But the labor organizations have begun to flood the Post Office Department with protests, and to appeal to Senators and Representatives to press their remonstrances upon the department. They complain that the use of the street cars as regular mail carriers will mean that striking employees of the street railway companies will not be able to obstruct the free movement of the cars without laying themselves open to punishment for interfering with the United States mails. A spokesman for the American Federation of Labor is said to have remarked:

"We shall oppose any proposition that looks to furnishing the protection of federal courts and troops to the operation of a private enterprise employing a large number of workingmen, under the guise of protecting the mails. The car companies have tried this before, but we have succeeded in tying them down to the use of certain special cars, appropriately labelled, and not permitted to carry any passengers."

Other schemes to improve service are also on foot. With the beginning of the year a number of entirely new devices in postal business will be tested. One is a new mail box, which is said to be the most perfect arrangement yet made to keep tab on letter carriers and collectors. The boxes will be arranged on a regular route and numbered. Each will be connected by a wire with an annunciator board in the main office and as the collector opens the box to take out the mail a bell will ring and an index on the board will tell the box that is open.

The electrical connections on the new box are so fixed that if the collector fails to open a box by reason of forgetting it or because it fails to work and he cannot get the door open, there is a wire which prevents his opening the next box in the series and the fact is also announced at the main office. This makes sure that the collector is doing his duty and that every box is opened at each collection.

There is a third novelty in the new system. In each box there is to be hung on the inside a telephone transmitter and receiver and, if at any time the collector should need to communicate with his chief at the office, he can do so, or the latter can tell from the annunciator just where he is and talk with him if necessary.

There will be also elaborate tests during January of the automobile as a vehicle for mail carriers and collectors.

London Underground Roads.

It is reported from London that all of the bills of the Underground Electric Railway Companies of London, Limited, have received the royal sanction, and this company, which has been fathered by the Speyer Brothers, of London, is in a position to carry out its undertaking as a whole. Work on Baker Street & Waterloo, the Brompton & Piccadilly and Great Northern & Strand roads, which have, under a recent bill, been consolidated, is being pushed rapidly, and 18 months should show these roads nearly ready for business.

The electrical equipment of the Metropolitan and Metropolitan District Railways is proceeding rapidly, and within a year these roads, known as the old underground, should be operated by electricity in a bright subway lighted by electricity, with good ventilation and frequent service in lieu of the smoky eight-minute steam service of the past.

Of the total capital of $25,000,000 of the Underground Electric Railway Companies, 50 per cent has been called on the stock subscriptions, making $12,500,000 paid in. It is not expected to call the other $12,500,000 at the present time, but the increased cost of the building of the underground roads will be provided for by the sale of debentures and guaranteed preference shares, issued under the acts of parliament by the underlying operating roads. Of the above $12,500,000 paid in upon Underground Company stock the United States furnished about one-half and Boston furnished about one-half of the United States subscriptions.

A New Trolley Bridge for Greater New York.

Mayor Low has outlined the plans submitted by the commission of experts for the new bridge to span the East River and pass over Blackwell's Island, New York. The expert commission comprised Profs. Burr and Ricketts and Henry W. Hodge. Their plan, in effect, is to build a bridge 91 feet wide to take the place both of the original plan and of that submitted by Commissioner Lindenthal. The general arrangement will be very similar to that suggested by Commissioner Lindenthal, but it will follow the original plan of giving space for the trolley tracks to run in lanes of their own, so as not to interfere with wagon traffic. Four trolley tracks are recommended. The plan provides for sidewalks, so that in case of accident all of the passengers would be able to leave the cars and finish their journey across the bridge on foot. The two lines of L roads will run parallel to the sidewalks. The lower deck is to be arranged with two trolley lines on overhanging brackets, one outside of each truss, with two additional trolley lines inside the trusses. Then it is recommended that a roadway be built in the center between these two inside trolley lines.

CURRENT NEWS AND NOTES.

OLD CARS AS PARK SHELTERS.—It is noted that the Cardiff Town Council furnishes another example of the advantage of coordination between different municipal departments. As its tram cars get too old to stand the heavy demands made on them for traffic it proposes to use them, with a little suitable decoration and fitting up, as park shelters.

WIRELESS TELEGRAPHY IN MEXICO.—A correspondent in Mexico informs us that the Mexican government is establishing a system of wireless telegraphy between Guaymas, State of Sonora, Santa Rosalia, and other points on the peninsula of Lower California across the Gulf of California. The work is in charge of Otto Scheller, an engineer of Berlin, Germany. The Slaby system will be used.

ELECTRIC BILLIARDS.—A cable dispatch from Paris of December 13 says: The very latest thing in Paris toys is an electric billiard game. It is played on a diminutive table, which can be folded up into the size of a small workbox. The balls are made of compressed pitch. The cue is a penholder with a cork disc at the end, forming a small mallet. The cue is chemically prepared. In the center of the table is a plate formed of any material which can be easily electrified. The game consists in attempting to make caroms by counteracting the electric influence behind the tiny balls. A practical player may run up a series of caroms, but a novice will find it not at all easy. The game is fully entitled to be called one of skill.

MARCONI AT GLACE BAY.—A special telegram from Halifax, N. S., of December 13 says: The *Glace Bay Gazette* published a very pessimistic article on Marconi's wireless telegraphy work here, insinuating he has failed up to date in bridging the Atlantic. It is understood the difficulty is due to insufficient power. Messages are being exchanged, but not as successfully as had been expected, and in the hope of remedying this it is rumored they are putting in a lot more storage batteries. Marconi will not go on the *Carlo Alberto* to Venezuela if the vessel gets out of the ice, but will stay here. The price of wireless stock has dropped twenty points within a month. Insiders are optimistic that the system will be on a commercial footing by Christmas day, and account for the present rumors by Marconi's aversion to giving out any news until he has his plant thoroughly equipped and is ready to take the public into his confidence. Mr. Marconi, in reply to inquiry regarding the statement published in the Glace Bay newspaper says: "I do not consider it worth while to notice such apparently wilful misstatements as those referred to claiming that I had met with failure. They are an entire fabrication." In the meantime, the *Carlo Alberto*, the Italian warship placed at Mr. Marconi's disposal by the King of Italy, has been dispatched to Venezuela to press Italian claims in that quarter.

CASTNER MEMORIAL TABLET.—A memorial tablet to the late Hamilton Y. Castner was unveiled December 16 in Havemeyer Hall, Columbia University. Mr. Castner, who died in 1899, was an alumnus of the Columbia School of Mines, and the tablet erected was provided from subscriptions among his large circle of professional admirers.

PARIS AUTO SHOW.—The most important automobile exhibition ever seen in France is attracting a large number of visitors to the Grand Palais, Paris. The show is not only artistic, but is striking testimony to the importance of the industry. A car which attracts much attention uses a combination of petroleum and electricity and was made partly by Daimler and partly by Lohne, of Vienna. The power is conveyed directly to motors on the front wheels from a 28-hp Mercedes engine, which drives a dynamo. The advantages of this new car are said to be the complete absence of side-slip and the abolition of the chain and speed gear.

SUBMARINE BOAT TESTS.—The board of naval officers appointed to conduct the trials of the submarine torpedo boats *Adder* and *Moccasin* have submitted their report on the *Adder* and recommended the acceptance of that vessel after certain defects and unfinished work are completed satisfactorily. The board calls attention to the fact that although the trials fulfill the strict letter of the contract, they do not provide for any trial under service conditions at sea, and no prediction can be made "as to her behavior in even a moderate seaway." The report therefore recommends that when the remaining vessels of this class are tried, one of them should be given sea tests.

PROPOSED STATE LABORATORY.—A telegram from Schenectady, N. Y., of December 9 says: An important meeting of the New York State Electrical Laboratory Commission was held here yesterday afternoon. There were present State Engineer Bond, Harold W. Buck of Niagara Falls; C. P. Steinmetz, of this city, and State Architect Hines. Plans already submitted to the commission were approved and Messrs. Buck and Steinmetz reported on the amount of space needed for the electrical apparatus. The cost of the proposed buildings and equipment will be between $250,000 and $300,000. The buildings alone will cost in the neighborhood of $100,000. The commission decided to make a preliminary draft of its report to be presented to the Legislature at the next session of that body.

A GREAT TUNNEL FRANCHISE.—The Pennsylvania Railroad obtained on December 16 from the New York Board of Aldermen, by a vote of 41 to 36, the right to tunnel under the Hudson River to the Borough of Manhattan, to the projected terminal of the company below Thirty-fourth Street, between Seventh and Ninth Avenues, thence eastward under the East River to the Borough of Queens, to connect with the Long Island Railroad system recently acquired by the Pennsylvania Company. The company proposes to spend $50,000,000 on the improvement and in return for the franchise the company claims that the people of New York City will be given exceptional transit facilities with the aid of electricity. The fight for the passage of the tunnel franchise has been long and bitter.

KANSAS ASSOCIATION MEETING.—At the recent meeting of the Kansas Gas, Water & Electric Association, which was well attended, Mr. R. C. Maunsell, of Topeka, Kan., presented an interesting paper on the economy of adapting old central stations to modern methods. Another interesting paper was read by Mr. S. W. Sterrett, of Kansas City, Kan., entitled "Why the People Distrust Gas, Water and Electric Companies." Professor Lucien I. Blake also favored the Association with a lecture on "Some Recent Discoveries in Electricity." The following officers were elected: President, Jesse Shaw, Topeka, Kan.; first vice-president, W. T. Soden, Emporia, Kan.; second vice-president, C. R. Maunsell, Topeka, Kan.; third vice-president, J. D. Nicholson, Newton, Kan.; secretary and treasurer, S. W. Sterrett, Kansas City, Kan.; executive committee, R. C. Johnston, Lee Riley and J. C. Nicholson.

THE CHICAGO ELECTRICAL ASSOCIATION elected officers for next year at its meeting December 5: For president, Prof. P. B. Woodworth; vice-president, Peter Junkersfeld; secretary, W. B. Hale; treasurer, H. G. Dimick; auditor, DeW. C. Tanner; directors, W. J. Warder, Jr., C. W. Whitney, Albert Scheible. The paper of the evening was by Capt. A. D. Khotinsky, on the "Early Development of European Incandescent Lamps." Capt. Khotinsky was associated with Jablochkoff and Maxim in their pioneer work of thirty years ago. In 1873, he was awarded the Royal Engineers' Medal for the first practical incandescent lamp. His paper was an interesting review of some of the inside history of the early work on the incandescent lamp in Europe. The next meeting of the association will be Friday evening, January 16, 1903, at which time a lecture will be given by H. M. Brinckerhoff, on "Third-Rail Electric Railway Systems."

POTASSIUM CYANIDE FROM AIR.—Prof. Edmund O'Neill, of the chemistry department of the University of California, declares that he can produce potassium cyanide from the atmosphere at less than half its present cost. If he succeeds this will reduce the heavy cost of treating gold ore. Using simple apparatus, gas of petroleum or coal is mingled with the atmosphere, which is four-fifths nitrogen. Subject to the influence of an electric arc, the resultant is hydrocyanic acid. This, when treated with potash, rapidly yields potassium cyanide. The cost of materials is small and the requisite energy to produce the combination is also inexpensive. The process of producing potassium cyanide is, it is said, now so expensive that more than $2,000,000 is spent annually on imports of the chemical. Its use is so general that besides the amount imported eighteen factories in this country turn out large amounts of it yearly. Prof. O'Neill says he can produce it for five cents a pound. Under old methods it costs 25 cents a pound.

CABLES IN THE PACIFIC.—The Pacific cable, in connection with the Canadian Pacific telegraph lines, was opened for business on December 8. The Commercial Pacific Cable Company has filed with the Secretary of State of New York an amended certificate of incorporation covering extension of its lines from Manila to Shanghai. The company has a New York charter. The American shore end of the Commercial Pacific cable was successfully laid on Sunday last, December 14, at Ocean Beach, near San Francisco, in the presence of thousands of spectators. Among those present on this interesting occasion were President Clarence Mackay, George G. Ward and other officers of the cable company, Governor Gage, of California; Mayor Schmitz, of San Francisco, and a distinguished party of guests. Governor Gage delivered an address, and his little daughter Lucille christened the splicing of the cable. The cable steamer *Silvertown* is now on her way to Honolulu, paying out the cable as she goes along.

LETTER TO THE EDITORS.

The Size of Atoms.

To the Editors of Electrical World and Engineer:

SIRS: I am obliged for your comments (in issue of November 22) on my paper on the size of atoms before the Physical Society of London, and particularly for the sight of that blessed word "bicron." Bicron is good. Its rhythm would place it in two-time measure; but what will the philologists say? My slight upon the diameter of the sun will surely merit a lighter sentence. You seem to have acted from malice prepense, while I was chained down to hard and fast figures.

It is easy to understand that on your side there may be some objection to atoms being rather small, but not that anything can be too big, not even the necessary sphere of 1,000 sun diameters. We are not on familiar terms with the sun over here, but as a matter of ethics I think his personality might have been kept out of the question.

Why should I not take "convenient hypotheses"? This quality of convenience is an attribute of their natures—not my creation; you see, I just snapped them up unawares and caught them in a natural state. If an atom is not a sphere, what is its shape? Further, if we put a number of apples in a bushel measure, we predicate contact at their adjacent surfaces. Who says there is one set of physical laws for things large, and another set for things small? What happens to the unlucky mass which is neither large nor small? Does he work "on his own"?

I carefully guarded myself against the equality in size of the

hydroxel and hydrogen ions. The authors lead me to believe that this is so, though they do not say so in so many words. This equality was hypothecated to remove from discussion a question which I propose dealing with in a subsequent paper. But whatever values we can reasonably attach to the elements of the problem, the result will be varied within very narrow limits only. I expressly stated in my paper that pending agreement on the value of the constants, the figure found, 114½ millions to the linear cm, was to be regarded as approximate only.

In the course of the discussion—I quote (in first person)—from the official report of the paper in *Nature*—Lord Kelvin said, "The value obtained by Mr. Ridout for the diameter of the hydrogen ion is almost exactly one-half of that which I have obtained for a molecule of hydrogen. The fact might be a coincidence. I have dealt with a sphere which would have the same effect as a double atom of hydrogen. While avoiding the assumption that atoms are hard and spherical, it is usual to treat them as such for the purposes of calculation."

What makes the coincidence the more remarkable is the fact that at the time I was not aware of Lord Kelvin's latest mathematical investigation, upon which his remarks were based.

You say in conclusion that the end is not in sight. This is welcome. It gives us prospect of many pleasant encounters in the future.

Clapham, London, England. H. V. Ridout.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Design of Direct-Current Dynamos.—Mavor.—His presidential address to the Glasgow Local Section of the (Brit.) Inst. Elec. Eng. In a former paper he had suggested that the essential part of the dynamo is the region occupied by the armature conductors in the magnetic field, and proposed the name "active belt" for this region which is bounded by the principal surface of the armature, the surface of the core at the bottom of the slots, and the ends of the core. He pointed out that an examination of the dynamo in terms of the energy generated in this active belt shows that machines of widely varying size, output and speed, give a remarkably constant value in watts generated per cubic centimeter of active belt at unit velocity in unit field. S. P. Thompson later confirmed this from calculations of a large number of machines. 5 ergs per second, or 0.000,000,5 watt per cb. cm. at unit velocity in unit field may be counted on as a safe load. The application of this method to machines of smaller size has, however, shown that this value must be subjected to considerable modification, the reason being that in the smaller machines the losses in the armature are relatively more important than in the larger sizes. In machines with armatures 24 in. in diameter and upwards, it appears that the output may safely be given in watts per revolution, i. e., a given carcass will give an output directly or nearly directly proportional to the speed of rotation of the armature. He calls attention to the rapidly increasing market for smaller machines and the special points to be taken into consideration in their design. He discusses at length the limit set by the temperature rise; it is customary to specify this rise at 70 to 90° F. above the temperature of the surrounding air; but on small machines this is an exceedingly uncertain standard. He gives a formula for the total watts generated in the winding of a dynamo or absorbed in the winding of a motor armature. It shows that the total output of the armature varies as the square root of the loss in the winding and directly as the speed. If the loss in the winding be relatively small, the output will, for practical purposes, vary directly with the speed; this is the case in large machines; in small armatures, on the other hand, the winding loss is relatively large; he treats this case graphically and shows that for every machine there is a maximum possible output for a given rise of temperature, and this maximum is at a definite speed of rotation. The conditions may be changed by various means; for low speed the total watts and the efficiency are greater with a deep slot and high inductions. The ratio between the iron and the copper can be adjusted to suit the conditions of work to which the motor is likely to be subjected. If, for example, it has to run constantly with a varying load from an outside supply, paid for by meter, the iron losses should be kept low and the copper losses high, whereas if the machine is to run at full load it should be designed to give the output under the most favorable conditions of combined iron and copper losses; attention to this point results in a very considerable saving in cost of working. Increase of core induction, slot depth, air-space induction, and tooth induction, all have the same effect upon the output curve of a machine as increase in speed, and increase in slot depth produces by far the most conspicuous change. The iron losses decreasing with decrease in slot depth, a point is reached when the slot becomes too shallow to hold the wire, and a limit is reached in this direction; if the wire be outside the slot, the risk of eddy current loss must be taken into account; he is not in favor of enclosed machines. He finally gives a diagram showing the difference in output obtained with different design and maximum output obtainable from a given carcass at various speeds.—Lond. *Elec.*, November 14.

Murdoch and Mavor.—A communication by Murdoch on the hysteresis loss in armatures, and Mavor's reply.—Lond. *Elec.*, November 28.

Calculation of Direct-Current Machines.—Korrodi.—An article in which he points out that the design of cheap and good machines requires the utmost attention to the danger concerning the details of the process of commutation; the e.m.f. of self-induction of machines is to be measured and in each case one should consider which value it may have. For this purpose he uses tables for the magnetic conductivity of the magnetic circuit which may easily be obtained by calculation and measurements. After the ends of a coil were separated from the commutator, the resistance was measured by determination of current and e.m.f. with direct-current, and afterwards the impedance with alternating current of 50 periods; for these tests the armature is removed from the magnetic field. He gives a table showing the results of such a test; by gradually enlarging such a table, one soon gets enough material for determining the self-induction for all existing slot dimensions; the proper choice of this value is the most important point of the calculation. For large machines with 550 volts between the terminals, Parshall and Hobart give this value at 8 volts, while Rothert considers 4 volts to be the normal value for similar machines. With the latter value the author has obtained good results for machines of small and medium size. It is necessary to hold the self-induction within moderate limits and to leave a part of the commutation work to the brush resistance; this part can naturally be the greater, the greater the voltage loss due to brush resistance. He recommends the following steps in choosing the dimensions of the armature: Determine approximately the dimensions from the usual formulas; then choose the magnetic flux and number of turns; determine the magnetic conductivity of the slots with the aid of the above empirical tables; calculate the self-induction and then change accordingly the number of turns and the dimensions; calculate again with the new dimensions, and definitely choose the self-induction with regard to the coil resistance and especially the brush resistance.—*Elek. Zeit.*, November 27.

REFERENCE.

Commutation.—Rothert.—The first parts of a full illustrated English translation of his German article on the theory of commutation.—Lond. *Elec. Eng.*, November 14, 21.

Lights and Lighting.

Mercury Vapor Lamp.—Arons.—A communication referring to some points in an article by Recklinghausen on the Cooper-Hewitt lamp. The author claims that water cooling does not increase, but decreases considerably the danger of breaking. In his own investigations (made with the mercury vapor lamp several years ago) he fully recognized the great importance of the density of the mercury vapor. The relatively large resistance required can be diminished

if several lamps are used in series. He protests against considering "certain devices as the property of Hewitt," as he would like to hold the mercury lamp open to improvements without hindrance; it is for this reason that he himself did not take a patent for the underlying principle, namely a mercury vapor arc in a complete vacuum. He says that the lighting by a shock of high potential has been used for a long time, probably first by Herschel, in 1840; Arons also used it. The introduction of a positive iron electrode is not due to Hewitt; Arons used it. He finally adds that he does not want to belittle Hewitt's merit, but wishes to insure freedom to other experiments.—*Elek. Zeit.*, October 23.

POWER.

French Power Transmission.—An extremely long and profusely illustrated article on the hydro-electric plant near Grenoble, which supplies many plants along the industrial valleys of the Eure and the Morge. The plant contains five turbine-driven alternators, each of 1,350 hp, and two 150-hp sets for exciting. The alternators generate three-phase currents at 3,000 volts, the voltage being raised to 26,000 for transmission. Induction motors are used by the consumers at various voltages, according to the special conditions. The price of the hp-year is 150 francs ($30) for a day of 24 hours and 125 francs ($25) for a day of 12 hours.—*L'Ind. Elec.*, November 10.

French Waterpower.—An article illustrated by maps, on projects of utilizing the hydraulic power of the upper Drac River in the French Alps, where there are several available falls. The Ponsonnas fall is discussed at some length and it is estimated that the development of 20,000 hp would cost about 2,000,000 francs, or 110 francs ($22) per hp, if 10 per cent. is allowed for unexpected expenses. If only 9,000 hp are first developed, the expenses are reduced to 1,650,000 francs, i. e., 200 francs ($40) per hp, and the final development of the total power would require 550,000 francs, or 55 francs ($11) per hp, including the 10 per cent. for unexpected expenses.—*L'Eclairage Elec.*, October 18.

Mexico.—BRATMAN.—A well-illustrated article on the power transmission and distribution in the valley of Mexico. There are five hydro-electric stations with a total of 19 generating sets, each consisting of a turbine-driven, 225-kw, 440-volt, 2-phase generator; 22 transformers of 225 kw raise the voltage to 22,000 for the transmission lines. In the La Veronica station the voltage is reduced to 2,600 volts for distribution in the City of Mexico.—*L'Eclairage Elec.*, November 1.

TRACTION.

Manhattan Elevated Railway of New York.—An article on the rolling stock of this company, which has 1,286 closed cars and 96 open cars. Of the closed cars, 850 are motor cars; none of the trail cars is equipped with motors. The standard train consists of six cars, of which the first, third, fourth and sixth are motor cars; each motor car is equipped with two 125-hp motors controlled from the front car; with other lengths of trains there are always two motor cars for each trail car. Each electric heater carries three coils which are exactly alike; different gradations of heat can be secured by throwing one, two or three coils into service. The company is using a novel fuse made of a copper ribbon 7½ in. long, 1¼ in. wide and 10 mils thick; it has a hole in the middle ½ in. in diameter and carries about 300 amperes. The chief point in favor of a fuse of this kind is that it is absolutely reliable, and when it burns away only a very small part of the fuse burns, as the ribbon is flexible and the ends turn themselves back. A novel feature of the wheel on the motor truck is the extended hub on which the solid steel gear is pressed. In this way all tendency of the motor to break the axle by torsional strain is removed. Another novel feature of the equipment is the device for cleaning the sleet off of the third rail, which is a very important problem on third-rail railways. Each car is equipped with four steel brushes which are pressed down on the track by pneumatic means by the movement of a valve in the motorman's cab.—*St. R'y Jour.*, December 6 and *Int. Ed.*, December.

Worcester & Southbridge Street Railway.—A description of this road, which is one of the latest high-speed roads completed in New England, and connects the cities of Worcester and Southbridge, Mass. At the ends current is supplied from rotary sub-stations to the trolley wire. The transmission is at 11,000 volts, the power station being situated near the center of the road. The generators are double-current machines supplying both direct current at 555 volts and alternating current at 355 volts, approximately. They are of 400 kw capacity, having a speed of 115 r.p.m, giving 3,000 alternations per minute. The generators have given excellent satisfaction in this plant, it being possible to take nearly the total capacity of the machine from either the collector rings of the alternating-current side or the commutator of the direct-current side. There are two sub-stations, one at the Southbridge end of the line and the other at North Oxford near Worcester. These are equipped with six 75-kw, oil-cooled, step-down transformers, and two 200-kw rotary converters. Each car is equipped with four 35-hp motors.—*St. R'y Jour.*, December 6 and *Int. Ed.*, December.

Paris.—An article giving some notes on heavy electric traction in Paris. Particulars are first given of the locomotives and third rail used by the Paris-Orleans Railway on a section 4 km in length between the Austerlitz station and the Quai d'Orsay station in Paris. The locomotives weigh 49 tons each, and each is equipped with four motors. The shoe is made of a lower wearing part of cast iron and an upper part of steel riveted to the lower part. The third rail is protected by a wooden guard. Insulators of beechwood which have been dipped in asphalt are used. The overhead conductor used in stations, track yards and other points where the insulation of the third rail is not considered desirable is illustrated: Some particulars are also given of the Paris-Versailles line owned by the Western Railway Company of France. This company made some experiments at first with compressed-air locomotives and then with electric locomotives. The latter are somewhat curious in construction, as the armature is supported on a hollow shaft, which is spring-supported from the car wheels. In some cases the motors are geared and in other cases gearless motors were used. The locomotives proved to be cumbersome and inefficient and the multiple-unit system is now in use.—*St. R'y Jour.*, November 15, and *Int. Ed.*, December.

Third-rail Traction in Italy.—A description of the power station and third-rail system of the railway between Milan and Porto Ceresio, in Italy. The company is planning to operate its line by water power, but in the meantime has installed a steam plant. The third rail is of the Vignole type weighing 45 kg per meter and bonded with flexible copper bonds of 200 sq. mm section. The shoe is of a novel type and has a very broad bearing surface, 317 mm x 254 mm, to clear a wooden guard which is placed over the third rail in the switch yards and at the stations; this guard is shown in one of the photographic views.—*St. R'y Jour.*, December 6, and *Int. Ed.*, December.

Three-Phase Motors for Traction.—NIETHAMMER.—A communication in which he claims that the polyphase induction motor with the ordinary connections heats with repeated starting more than a direct-current series motor in the same space; or in other words, given a direct-current locomotive built with so greatly intermittent service that its rationally chosen direct-current motors become very hot (150° C. and more); if polyphase induction motors would be introduced instead, they heat still more, if no artificial means for cooling are applied. He says, however, that he does not claim that the induction motor is generally inadvisable for traction.—*Elek. Zeit.*, November 27.

Ward Leonard Single-Phase Traction System.—GEIPEL AND LANGE.—A communication in reply to some critical editorial remarks recently noticed in the Digest. The Ward Leonard system provides for delivering the necessary current at a low voltage without any resistance in the main current, to do which it uses only a small current at the full voltage; the power required by the motors at the moment of starting is therefore small. They deny that the question is entirely one of fluctuation of power. With the Ward Leonard system the current rises gradually to a maximum shortly after starting and then falls gradually to the value required at full speed.—Lond. *Elec.*, November 28.

REFERENCES.

Polyphase Transmission of Traction.—An editorial on overdoing a good thing. A note of warning is sounded that polyphase transmission with converter sub-station is being installed in many cases where two or more direct-current stations can be operated cheaper.—*St. R'y Jour.*, November 29.

Overhead Wire.—HARVEY.—An article on the proper construction, inspection and treatment of the overhead wires for tramways.—Lond. *Elec. Rev.*, November 28.

Railway Working.—Tables showing the performance of the trains on the Liverpool Overhead Electric Railway. A diagram gives the current curve for acceleration of trains on this line under working condition.—*Elec. Rev.*, November 28.

Railway Signals.—A long and well-illustrated description of the "Crewe" system of railway signalling.—Lond. *Elec. Rev.*, November 28.

Wires, Wiring and Conduits.

REFERENCE.

Wiring.—Voigt.—An illustrated description of some apparatus to be used in the wiring of house installations for the purpose of maintaining a good insulation resistance against the earth.—*Elek. Zeit.*, October 23.

Electro-Physics and Magnetism.

Radio-Activity Apparatus.—Elster and Geitel.—A description of the apparatus used by them for studying the radio-activity of the atmosphere in places removed from physical or meteorological laboratories. In these measurements it is necessary to maintain the body to be "activated" for several hours at a negative potential of several thousand volts. To save the use of an induction coil or influence machine for this purpose, they substitute a dry pile of 6,000 couples arranged in 30 sets of 75 volts each, strung on ebonite rods, and enclosed in a metal case. When the pile is not in use, its discharge is retarded by disconnecting the sets and keeping the apparatus in a warm and dry room. It is, of course, necessary to control the potential of the pile by means of a high-potential electroscope; they use a Braun electroscope, but provide it with amber insulation and with an arrangement for drying the interior by means of sodium. A current cannot be taken from the pile, its only function being to keep the conductor at a potential of 2,000 volts. The pile will keep in good working order for several years if properly treated. It has been found satisfactory in the open air as well as in the moist air of cellars and caves, and can easily be renewed when worn out.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

Cathode Rays.—Lamotte.—An illustrated article describing experiments on the production of cathode rays by ultraviolet rays.—*L'Eclairage Elec.*, November 1.

Propagation of Röntgen Rays.—Blondlot.—A translation in full of his French paper in which he describes his experiments proving the speed of propagation of Röntgen rays to be equal to that of Hertzian waves or light.—Lond. *Elec.*, November 21.

A supplementary note in which he quotes some further experiments in support of his conclusion that Röntgen rays are propagated with the velocity of light.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28.

Influence of Metallic Screens upon Cathode Rays.—Des Condres.—An account of experiments in which he found that when cathode rays penetrate a thin metallic membrane like a Lenard "window" they lose in speed.—*Phys. Zeit.*, November 15; abstracted in Lond. *Elec.*, November 28.

Electro-Chemistry and Batteries.

Thallium Storage Battery.—Marsh.—An article on a new storage battery which is interesting from a theoretical point of view, although the author does not believe it to be suitable for commercial use. After discussing the chemistry of thallium, he describes the preparation of the cell as follows: A cell containing sheet iron electrodes is filled with a dilute solution of thallous oxide, which is soluble in water, to which some potassium hydroxide is added to increase the conductivity. If a current is then sent through the cell, spongy thallium is deposited on the cathode and thallic oxide in a hard black coating on the anode; neither of these is soluble in the remaining solution. This represents the charged cell. During discharge the thallium and thallic oxide are changed back into thallous oxide. An interesting comparison is given between the principal features of the thallium cell and the lead cell. Thallium is very expensive, but this would not necessarily be prohibition for its use in storage batteries. The principal difficulty seems to be that during charging it is very difficult to obtain compact, evenly distributed and adherent deposits. The cell is discussed in a separate editorial in which it is said that the solubility of an electrode may cause the failure of a battery for two reasons. The first refers to batteries with electrodes of two metals, if the electrode which is the cathode during discharge is soluble in the electrolyte, then its material may be deposited on the other electrode with resulting local action. The other reason why soluble electrodes are unsuitable for battery practice is that in charging it is impossible to obtain compact, evenly distributed and adherent deposits, as has been conclusively proved in practice with the lead zinc accumulator.—*Electrochem. Ind.*, November.

Electrolysis of Fused Caustic Potash.—Le Blanc and Brode.—An account of some experiments in which they continued their investigation of the electrolysis of fused soda and potash, recently noticed in the Digest. From their experiments they conclude with positiveness that it is impossible that by Castner's process in the presence of air, metallic potassium can be produced from pure, fused caustic potash, on an industrial scale. They think that Castner probably worked with fused caustic soda only, and that the impossibility of the production of metallic potassium by Castner's process is due to the fact that metallic potassium at that temperature is easily oxidized.—*Zeit. f. Elektrochemie*, October 23.

Electrolytic Bleaching.—An illustrated description of a new apparatus for producing bleaching liquids, the chief advantages of which are said to be cheapness of the product and simplicity. The salt solution flows down a sort of step-to-step arrangement of cells and at each step the electric current flows through it. The action of the new apparatus is said to be based primarily upon the fact that the salt solution is divided into thin liquid threads subjected to the action of the current.—*Elektrochem. Zeit.*, October.

Electric Furnace Processes.—Danneel.—Besides the processes already noticed in the Digest, the following, which have been worked out in the metallurgical laboratory of the Institute of Technology of Aix-la-Chapelle, are discussed. Preliminary experiments on the production of chromium, free from carbon, from chronic oxide, aluminium oxide, and carbon. Experiments of Stockem for producing cerium by electrolysis, the object being to utilize the waste materials of the gas incandescent lamp manufacture; cerium is best obtained from the fused chlorides, free from water; less favorable results are obtained with the reduction of the oxide; by the Goldschmidt reduction process cerium could not be obtained. Some experiments by Borchers and Dorsemagen on the preparation of red lead or minium from lead peroxide and lead oxide. Some notes on nickel refining, the modern "tops and bottoms" process being represented diagrammatically.—*Zeit. f. Elektrochemie*, September 25. (See this issue Electrical World and Engineer, p. 1002.)

Maxwell's Theory and Electrolysis.—Platner.—The conclusion of his mathematical article on Maxwell's theory of electricity and its importance for the theory of electrolysis. He arrives at what he believes to be a sufficient basis for the explanation of electrolytic phenomena without the use of any "fantastic hypothesis."—*Elektrochem. Zeit.*, September.

REFERENCES.

Sault Ste. Marie.—J. W. Richards.—An illustrated article on the present situation and the prospects of electrochemical industries at Sault Ste. Marie, with a detailed description and critical discussion of the Rhodin process of electrolyzing a sodium chloride solution for the production of caustic soda and bleaching powder.—*Electrochem. Ind.*, November.

Low Temperature Researches.—Dewar.—The first part of his presidential address to the Brit. Assn. This part deals with the history of the researches on the absolute zero point of temperature, the liquefaction of gases and continuity of state, and liquid hydrogen and helium. The importance of the subject for electrochemistry and physical chemistry in general is discussed in an editorial—*Electrochem. Ind.*, November.

Storage Batteries.—A continuation of a long serial on chemical and metallurgical industries at the Dusseldorf Exposition, deals with electro-chemical exhibits which were confined to storage batteries; those exhibited by various German firms are described.—Lond. *Eng'ing*, October 17.

Oxidation and Reduction Processes.—Bodlaender.—A long contribution to the theory of some technical reduction and oxidation processes. It seems to contain very valuable figures, but cannot be abstracted. At the end of the article the author gives the most important interpolation formulas for the free formation energies, relating to the oxidation of various substances.—*Zeit. f. Electrochemie*, October 30.

German Elektrochemical Patents.—An article giving some statistical data on the work of the German Patent Office in electrochemistry during the last ten years.—*Elektrochem. Zeit.*, October.

Pioneers of Electrochemistry.—The third part of this serial gives an account with portrait of the life and work of E. G. Acheson.—*Elecyrochem. Ind.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Efficiency of a Dynamo.—ASHWORTH.—An illustrated article on the following method for determining the mechanical power supplied to the generator from observations in the rate of change of the rotational energy of the armature under the conditions of full load. The machine is run at a velocity a little higher than the speed at which the efficiency is required and at which it is yielding full output; the driving power is then cut off suddenly and the rate of change of speed of the armature is determined as it slows down past the given speed. The rate of change of angular velocity at that speed measures the retarding forces, and hence the power to maintain the armature in rotation. This method may be used successfully with machines of the modern fly-wheel type. For determining the moment of inertia he plots two retardation curves, one for the armature by itself and the other for the armature loaded with a disc fly-wheel of known moment of inertia. He gives the numerical data of a test for determining the moment of inertia and its application for obtaining the efficiency of a dynamo.—Lond. *Elec. Rev.*, November 28.

REFERENCE.

Oscillographs.—BLONDEL.—A mathematical article, illustrated by diagrams, on the theory of oscillographs.—*L'Eclairage Elec.*, October 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Transmission of Pictures to a Distance.—DUSSAUD.—A description of a new type of selenium cell for electric vision at a distance. The transmitter consists of a plane non-conducting surface divided into equal squares of 5 cm side. In each of these is placed a coil formed of an insulating core, upon which are wound two thin copper wires covered with a layer of selenium prepared in such a way as to give it the maximum sensitiveness. One of these wires is traversed by a feeble current of the order of those in a telephone. When the selenium is illuminated it acquires a conductivity varying with the degree of brightness, and thus communicates some of the current to the second wire. This works a relay and brings into action a lighting circuit containing an incandescent lamp at the receiving station. At the receiver there is another surface divided into squares and each square contains an incandescent lamp. These lamps, therefore, reproduce the intensity of illumination at the origin. He claims that by this process of analysis and recombination, images may be reproduced at a great distance.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

London Telephone Exchanges.—An illustrated description of the Westminster and Kensington exchanges of the London Post Office, where arrangements are made for party lines.—Lond. *Elec.*, November 21.

Lightning Arresters.—FRANKE.—A long illustrated paper read before the Berlin Electrical Society in which he describes new lightning arresters for telephone lines.—*Elek. Zeit.*, November 27.

MISCELLANEOUS.

Ignition Devices.—LONGBRIDGE.—An illustrated paper on electric ignition devices in oil automobiles. He says that existing systems of electric ignition admit of improvements in two directions, in the automatic timing and in the "automatic consumption of current." He suggests using wedge-shaped contact pieces on a rotating disc and allowing the disc, under the direction of a governor, to have an in-and-out movement on the shaft, so that with increasing speed, the disc slides backwards, for instance, bringing the wider portion of the contact pieces under the brush.—Lond *Elec.*, November 21.

Typesetting Machine.—REYVAL.—A well-illustrated description of a new typesetting machine, used in the office of a Paris newspaper. It is of interest here on account of the use of electric devices not only for operating the machine, but also for the transmission to a distant point, of copies made by this machine.—*L'Eclairage Elec.*, October 18.

Surface Electric Locomotives.

In designing electric locomotives for surface haulage, the restrictions of gauge, limitations of height, width, etc. and other conditions frequently necessitate special construction but the Westinghouse Electric and Manufacturing Company have fixed upon the following types as covering the principal requirements: Four-wheeled pedestal type, with platform, open canopy or inclosed cab; four-wheeled mining type, with cab at one end, with central cab, or with cab over all; eight-wheeled double-truck type, with platform, open canopy or inclosed cab; eight-wheeled double-truck freight or passenger-car type; double eight-wheeled type.

Any of the above four-wheeled locomotives may be constructed with one or two motors. A two-motor equipment is generally preferable, permitting the use of all the adhesive weight for tractive purposes In case of accident to one motor, the locomotive is not helpless, but may be operated with the remaining motor. Eight-wheeled locomotives are usually equipped with four motors, but may be designed for but two, if desirable. Double eight-wheeled locomotives are two eight-wheeled locomotives coupled together, and may be operated separately. Other types are readily adapted to meet special conditions of service.

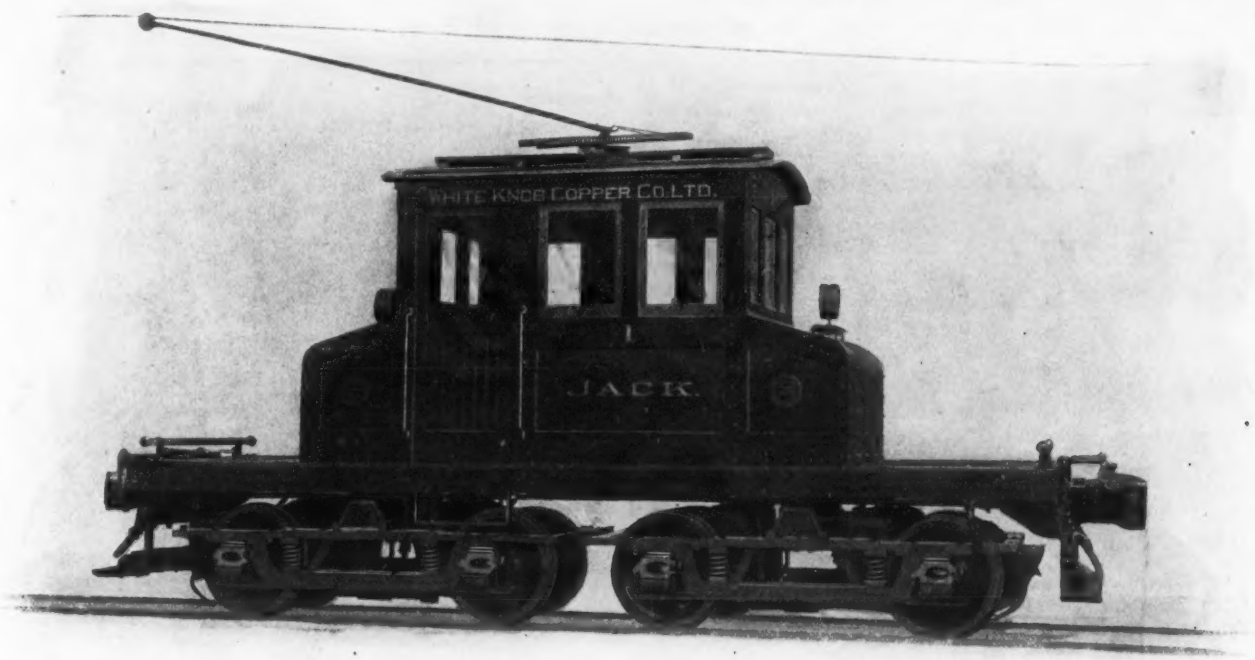


FIG. 1.—EIGHT-WHEELED ELECTRIC LOCOMOTIVE.

Two of the above standard Westinghouse types are shown in Figs. 1 and 2, the former having eight wheels, four 50-hp motors, and weighing 34,000 lbs.; and the second, four wheels, two 10-hp motors, and weighing 13,000 lbs.

As the motors are of the well-known Westinghouse railway type,

a description of the details of the locomotives will be confined to the controlling and other circuit apparatus. Two types of control are commonly employed for electric locomotive service, namely, the "series parallel" (Fig. 3), and the "rheostatic" (Fig 4.). With the "series parallel" control, the motors are first connected in series with each other and with a resistance which is gradually cut out of circuit; they are then connected in parallel with each other and in series with a resistance which, as before, is gradually reduced to zero. Thus there are two efficient running positions, viz., "series," giving half speed, and "parallel," giving full speed. With the "rheostatic control," the motors are connected permanently in parallel and in series with a resistance which is gradually cut out of circuit; this gives only one efficient running position, the "parallel"; all variations in speed must be obtained by throwing resistance into the circuit.

The "series parallel" control is the more economical, as less energy is dissipated in the resistance. For such work as yard shifting, however, the "rheostatic" is generally preferable, as the troubles due to slipping of wheels are reduced, owing to the fact that with two motors connected in series, if the wheels driven by one motor slip, the current through the other motor falls off, and the tractive effort exerted by it is consequently reduced; while with motors connected in parallel, if one slips its wheels, the tractive effort exerted by the other is increased, which tends, to a certain extent, to make up for the slip. Controllers of each type designed for handling two 500-volt, 50-hp motors are illustrated on the opposite page. In special

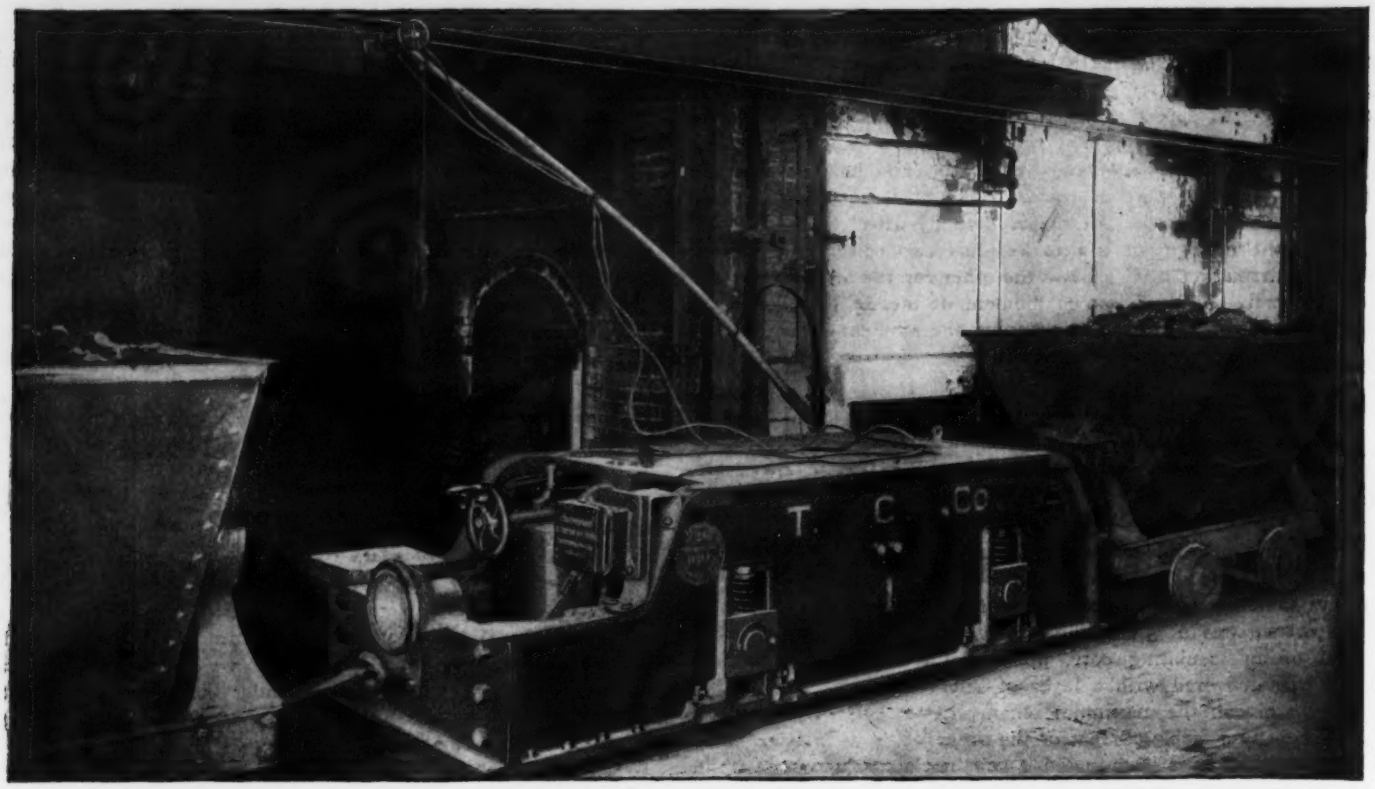


FIG. 2.—MINING LOCOMOTIVE.

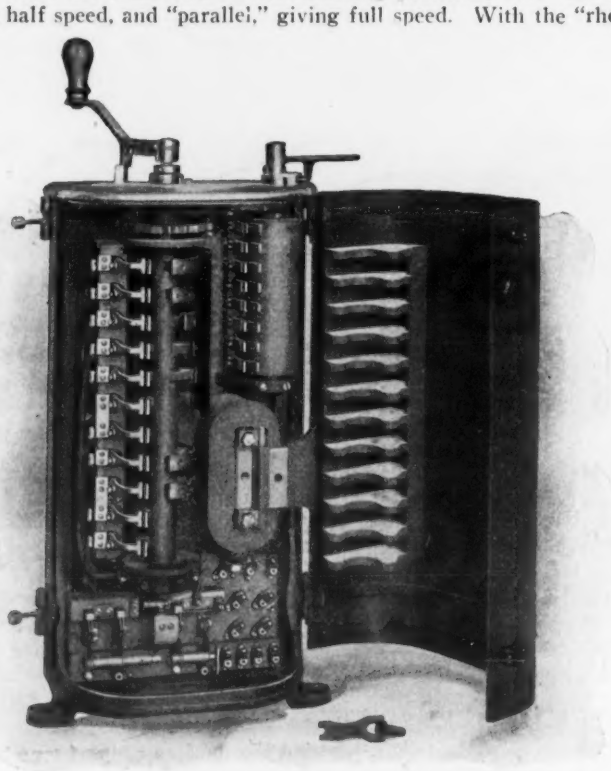


FIG. 3.—SERIES-PARALLEL CONTROLLER.

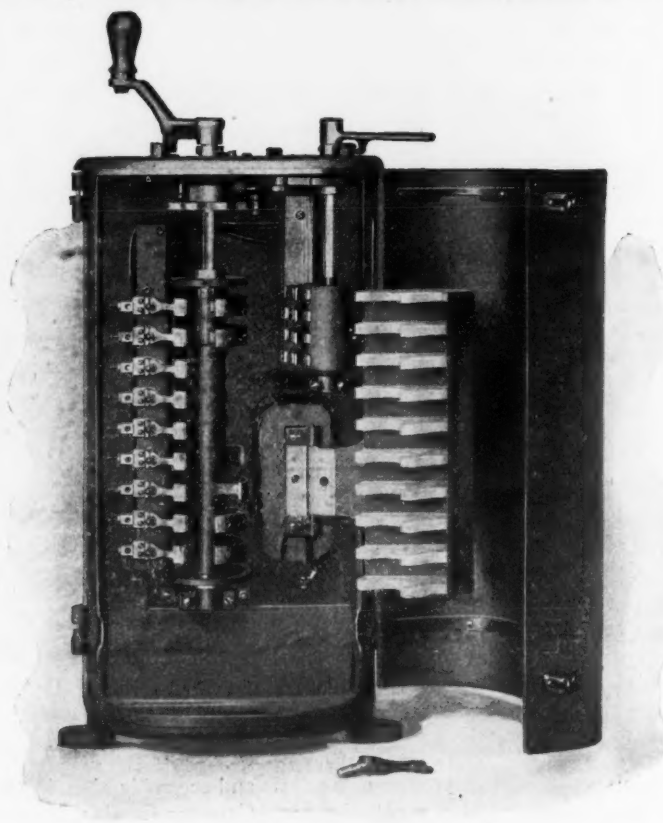


FIG. 4.—RHEOSTATIC CONTROLLER.

cases, a switch is provided with "rheostatic" control, by means of which the motors can be thrown in series if desired. Controllers are provided with a magnetic blow-out device, which reduces to a minimum the arcing at fingers and contacts.

Two standard forms of resistance are manufactured for locomotives—the "iron-clad cell" and the "grid" diverter (Fig. 5). The iron-clad cell diverter consists primarily of a strip of sheet metal wound in a spiral form on an iron cell with mica interposed between the layers. A number of these cells, mounted upon a section of insulated tube, are held together by lock nuts to form a column. This form of resistance has been in service for a number of years with marked success.

The "grid" diverter consists of a number of cast-iron plates mounted together in a frame, separated by means of mica washers, and so arranged as to give ample space between the grids for the free circulation of air. This form of diverter is very compact and durable, and is admirably adapted for out-door service. It is practically indestructible

An automatic railway-type circuit breaker is used, connected in the main circuit, which effectually protects the motors from dangerous overloads. Fig. 6 shows a 500-ampere circuit breaker of this type. The current at which the breaker will open the circuit may be varied by turning the milled nut, shown on the right-hand side of the case. These circuit breakers being provided with a powerful magnetic blow-out will open on the severest short-circuits which can occur with the voltage ordinarily employed for haulage work.

To protect the electric equipment from possible injury resulting from a lightning discharge, each locomotive is furnished with a Wurts' lightning arrester. Each arrester is completely enclosed in an inverted cast-iron box, with a lid on the bottom, thus preventing any possibility of moisture reaching the arrester. The case is carefully insulated from the arrester and from the ground trolley and connections

The trolley is designed to withstand heavy strains. The cast portions are of malleable iron, and the spring is of the compression type which has been found to be most satisfactory in service The

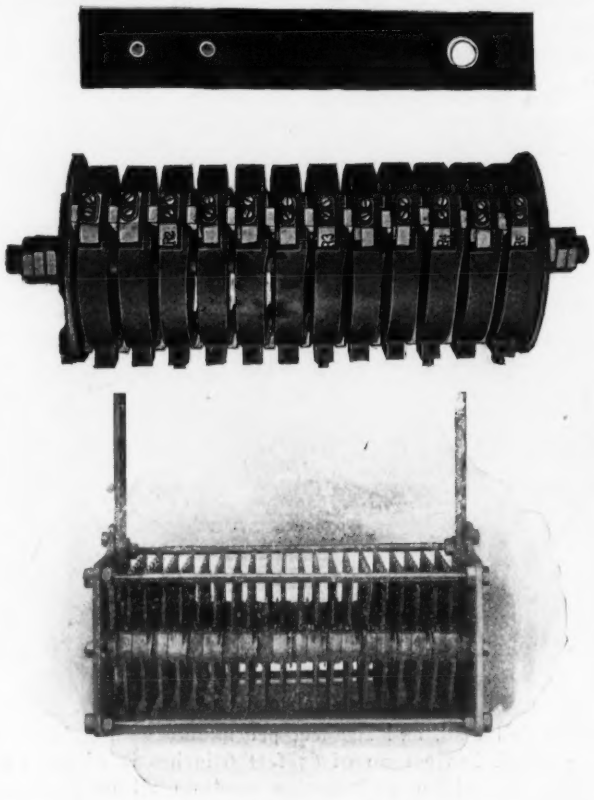


FIG. 5.—IRON-CLAD AND "GRID" DIVERTERS.

trolley automatically adjusts itself to the varying heights of the wire Where the current is large, a double tandem trolley is employed

In some industrial works the overhead trolley system is objectionable, either because of the multiplicity of switches sometimes necessary in the diversified transportation of a works' product, or because the use of an overhead trolley wire is not permissible. For such service, the Westinghouse electromagnetic switch system is applicable. No poles, overhead wires or troublesome switches are employed. Yards and buildings are free of all obstructions, the locomotive being supplied with current by cast-iron contact buttons. These are connected through electromagnetic switches imbedded in the track, to a feeder-cable laid along the track While in operation, all contact buttons are "dead," except those directly under the locomotive It is impossible, therefore, for any one to receive a

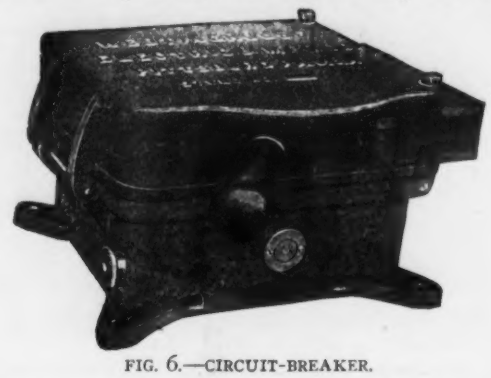


FIG. 6.—CIRCUIT-BREAKER.

shock—a distinct gain in safety over the trolley system. Among other advantages to be mentioned are the facility with which freight cars can be drilled in yards and through buildings without turning the trolley whenever the direction of a locomotive is reversed, and the absence of the necessity for guiding the trolley through the multiplicity of switches usually found in factory yards and buildings—advantages amounting often to the use of electric locomotives where otherwise electricity could not be used.

The Moore System of Vacuum Tube Lighting.

As is well known, Mr. D. McFarlan Moore has been engaged for some years past in the development of vacuum tube methods of lighting, in which he has made some notable advances, due notice of which has appeared in these columns. A very interesting installation illustrative of his latest work has recently been on view at 50 Broadway, New York City. The ordinary office room there in which the Moore vacuum tube is installed measures 18 ft. 4 in. by 13 ft. 5 in. It is shown in Fig. 1. The ceiling is 11 ft. 9 in. in height. The walls of the room are buff-colored for a distance of 7 ft. 7 in. above the floor, and above that are white. The ceiling also is white. In addition the three doors and door trims are white.

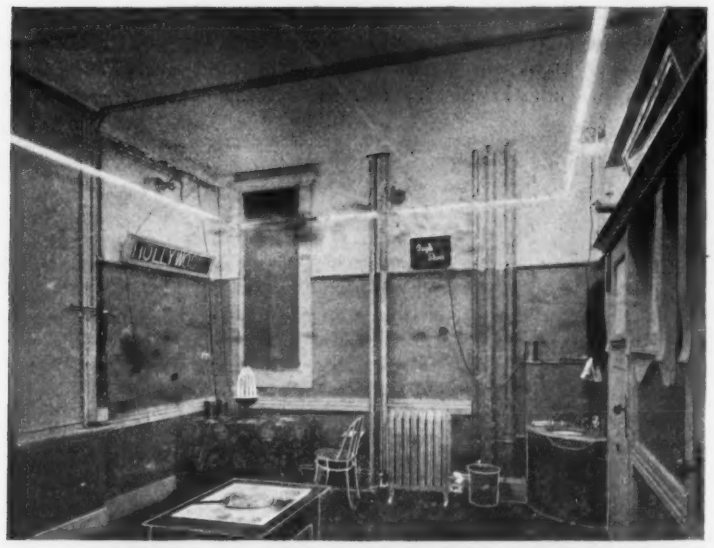


FIG. 1.—ROOM LIGHTED BY MOORE VACUUM TUBE.

The floor is painted dark brown, with a rug having a brown and buff-colored pattern.

The vacuum light tube is 1⅞ in. in diameter and is run around the room supported by six side brackets at a height of 9 ft. 6 in. above the floor and at an average distance of about 13 in. out from the walls. The total length of the exposed vacuum tube is approximately 55 ft. The tube is in one continuous length and its terminals enter a box placed near the ceiling, which box, Fig. 2, contains a special

high-voltage transformer. Current is obtained from a motor generator set consisting of 3-hp, direct-current motor, direct-connected to a special inductor type alternator designed by Mr. Moore. The direct-current motor receives current from the Edison 220-volt

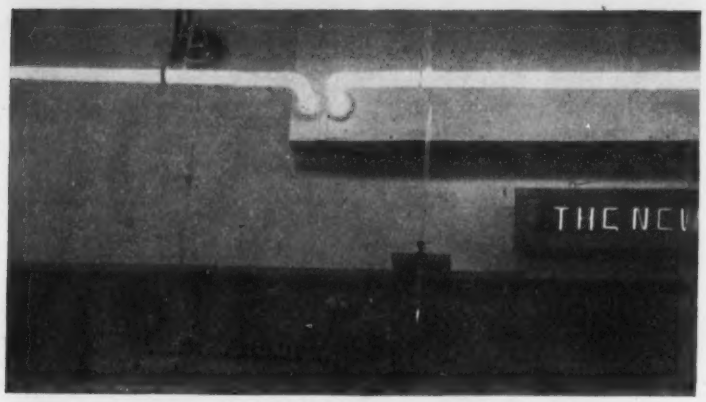


FIG. 2.—TRANSFORMER BOX AND ENDS OF TUBING.

street circuits and runs at about 175 r.p.m. The alternator, as designed, gives 57,600 alternations (28,600 cycles) per minute, with a potential of between 40 and 50 volts at its terminals.

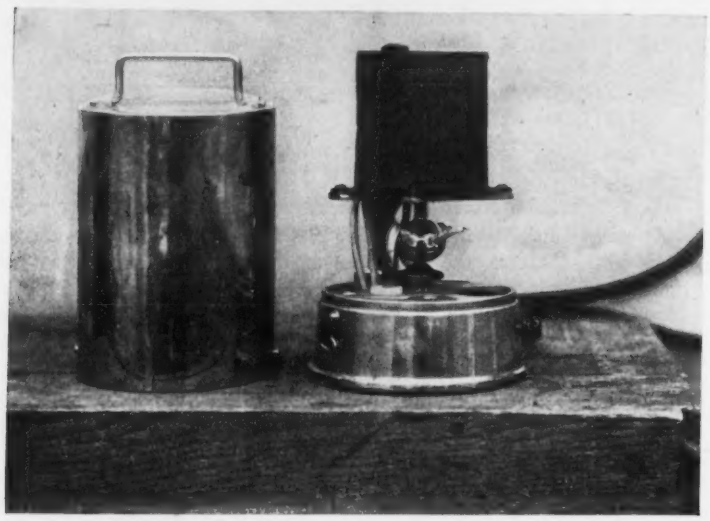


FIG. 4.—MOORE VACUUM BREAK VIBRATOR.

The wires from the alternator are led to the special transformer mentioned above, to which the tube is connected. This transformer has a ratio of 1 to 100, so that the potential delivered at

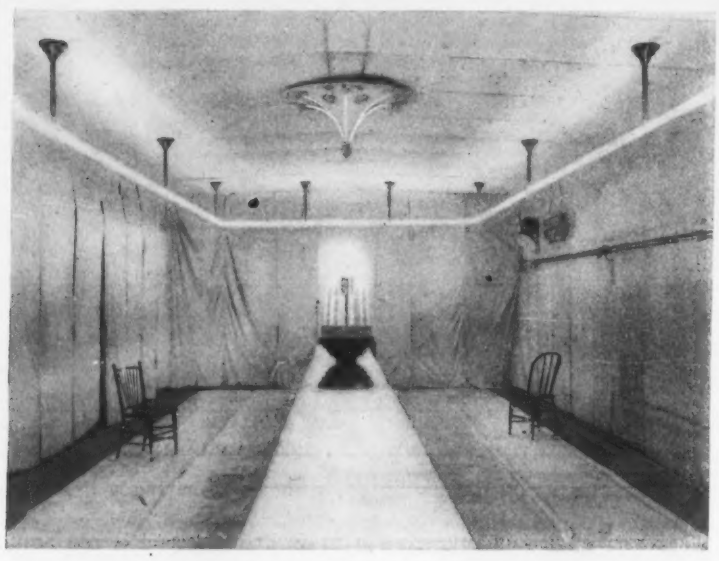


FIG. 3.—ROOM AND FOUNTAIN LIT BY MOORE TUBES.

the caps of the vacuum tube is approximately between 4,000 and 5,000 volts. The usual switches and rheostats are installed by which the light in the tubes can be controlled.

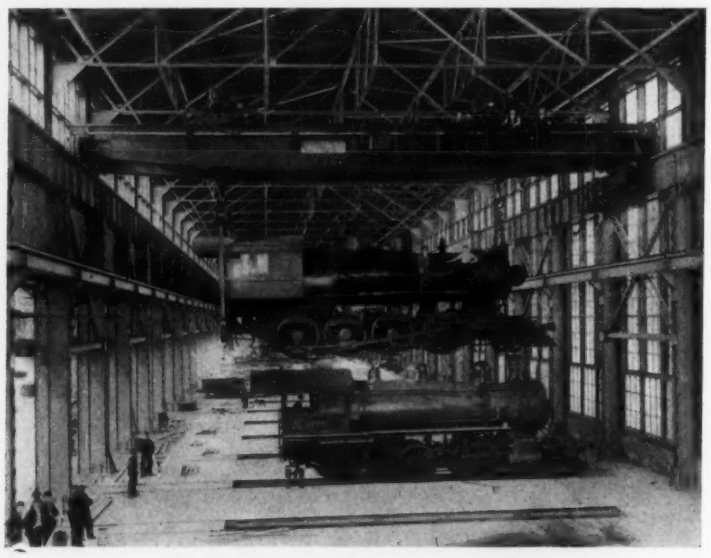
The tube shown in this room is built up from standard lengths of about 8 ft., which are joined *in situ* by simple and handy devices that Mr. Moore has worked out for the purpose, so that any length with any angle of bend can be made and run in a very few hours. As installed, and tested by one of the leading electrical experts whose report we have seen, good illumination is produced by the tube with 3.9 watts per candle, and brilliant illumination with 4.8 watts. Our own observation of the lighting is very satisfactory, the color being pure and cheerful and the diffusion perfect, as in a studio with proper north exposure in bright sunshine.

On the tables and sideboards in Fig. 1 are seen several devices, while on the walls are various signs. These are perhaps better brought out in Fig. 3, which shows a similar room, at the center of which a fountain plays, with light instead of water for its streams and jets. The different signs shown are operated by means of the special Moore vacuum break vibrator and coil shown in Fig. 4. The vibrator and coil are contained in the nickel-plated box, 8 in. high by 4½ in. in diameter over all. These vibrators are connected directly to the 110-volt Edison street mains that serve the office building, by means of the usual plug. They are extremely pretty and attractive, and, it would seem, might well be made a great advertising novelty, as well as a feature of spectacular displays of a kindred character. It is such work as this that makes one believe in the imminence of commercial vacuum tube lighting, toward which so much encouraging effort is now being directed.

Large Electric Crane in Railroad Shops.

The 100-ton, 5-motor electric traveling crane which has recently been installed by the Niles-Bement-Pond Company at the Collingwood shops of the Lake Shore and Michigan Southern Railway, is an interesting appliance. In the accompanying cut this crane is shown lifting an 80-ton, eight-coupled consolidation type locomotive. The crane is of the Niles standard design fitted with two 50-ton trolleys. The main hoist motors are each of 45 horse-power, and are capable of hoisting the full load at a speed of about 10 feet per minute.

The bridge motors traverse the bridge up or down the shop, which is about 530 feet long, at the rate of 150 feet per minute



100-TON CRANE.

with the full load, and 200 feet per minute with light load. The bridge which has a span of 65 feet 6 inches is of the company's standard box girder construction used on all its cranes, and is fitted with eight truck wheels running in heavy steel truck frames, which are securely rivetted to the box girders.

All gears on this crane are cut from the solid and run submerged in oil. Each trolley is equipped with the Niles improved automatic safety mechanical brake, which controls the load at all times, and an electrical brake mounted on the armature shaft which is "on" when the current is thrown off. The motors are designed especially for crane work, and are wound for 220 volts direct current. Each motor has its reversible controller and rheostat.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money was stringent all through the week, the closing rates being 7 to 8½ per cent. for short dates and 6 per cent. for 6 to 7 months. Stock market conditions were disturbed during the week, resulting in heavy declines, quotations generally touching the lowest level of the year. At the close of the week, however, there was a rally. The decline was mainly due to high rates for and scarcity of time money and the renewed hardening of call-loan rates. Industrial stocks, headed by United States Steel, were very weak on general selling. All the tractions and electric securities receded, in common with the rest of the market. Brooklyn Rap. Tran. fell to 59¾, but recovered to 61¾ at the close, the net loss being 2½ points. Met. St. Ry. touched 135, closing at 137, a net loss of 2¼ points; Manhattan lost a like amount on the week's trading, closing at 144, ex-div. General Electric moved within 172 and 179, closing at 174¼, a net loss of 2¼ points. The fluctuations in the two Westinghouse issues were more violent, common closing at 191, a net loss of 9 points, and preferred 200, a loss of 6 points. Western Union closed at 88, being ¼-point off from the last quotation. Following are the closing quotations of December 16:

NEW YORK.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
American Tel. & Cable	88	89	General Electric	178	174
American Tel. & Tel.	160	157	Hudson River Tel.	..	..
American Dist. Tel.	34	34	Metropolitan St. Ry.	139¾	136¾
Brooklyn Rapid Transit	64⅛	61¾	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	..	..	N. Y. & N. J. Tel.	163	162
Electric Boat	22	20	N. Y. E. V. T. Co.	10	9
Electric Boat pfd.	37	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3⅝	3	Western Union Tel.	87¾	87¾
Electric Vehicle	3¼	4	Westinghouse com.	195	188
Electric Vehicle pfd.	10	10	Westinghouse pfd.	200	..

BOSTON.

	Dec. 9.	Dec 16		Dec. 9.	Dec. 16
American Tel. & Tel	160⅛	159⅛	Western Tel. & Tel. pfd.	98¼	98
Cumberland Telephone	126	..	Mexican Telephone	2	1⅞
Edison Elec. Illum.	..	..	New England Telephone	137	135½
General Electric	..	..	Westinghouse	..	93
Western Tel. & Tel.	25	..	Westinghouse pfd.	..	93

PHILADELPHIA.

	Dec. 9.	Dec 16		Dec. 9.	Dec. 16
American Railways	..	..	Phila. Traction	97¾	97
Elec. Storage Battery	79	..	Phila. Electric	8⅛	..
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America.	9¼	9⅛	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Dec. 9.	Dec. 16		Dec. 9.	Dec. 16
Central Union Tel.	..	..	National Carbon pfd.	97	98
Chicago Edison	..	175	Northwest Elev. com.	..	..
Chicago City Ry.	208¾	..	Union Traction	13½	..
Chicago Tel. Co	..	..	Union Traction pfd.	45	..
National Carbon	26	..			

BRITISH WESTINGHOUSE.—The third annual report of the British Westinghouse Electric & Manufacturing Company, Ltd., for the year ending July 31, 1902, shows profits for the year, including the sum brought forward from last year, of £79,594 11s. 7d. Out of this an interim dividend of £23,257 16s. 4d. and debenture interest to the amount of £6,132 4s. 1d have been paid, and the directors propose to appropriate a further sum of £30,000, making a full 6 per cent. on preference shares. Of the £20,204 11s. 2d. remaining, £14,963 17s. 6d. has been written off for stamp duties and fees incurred on the formation of the company and the expenses connected with debenture issue, leaving a balance of £5,240 13s. 8d., which is placed to reserve account. The growth of the company's business is shown by the following figures:

Orders during the year July 31,				1899	£279,000
"	"	"	"	1900	547,000
"	"	"	"	1901	738,000
"	"	"	"	1902	932,000

and for the first four months of this year, viz., since July 31, 1902, the orders received exceed £825,000. This rapid growth of the company's business already necessitates an increase of capital and the directors will propose to the shareholders that an additional £200,000 6 per cent. preference shares of £5 each shall be created and to issue one-half of such shares at present. The company is in receipt of very large orders, all of which will now be executed at the Manchester works.

NEW YORK AND QUEENS LIGHTING.—The result of operations of the New York & Queens Electric Light & Power Company for the year ending August 1, 1902, are: Gross earnings, $307,669; operating expenses and taxes, insurance, discounts and bad debts, $146,668; maintenance, $23,973; total, $170,642; net earnings, $137,027; interest charges for year on all bonds outstanding, $116,775; surplus, $20,252. For three months ending October 31st the company's operations were:

	1902.	1901.		Changes.
Gross	$81,840	$74,345	Inc.	$7,495
Ex., tax. etc.	39,122	40,033	Dec.	911
Net	$42,718	$34,312	Inc.	$8,406
Fix. charges	29,375	29,012	Inc.	363
Surplus	$13,343	$5,300	Inc.	$8,043

The balance sheet as of August 1, 1902, shows a profit and loss surplus of $41,984.

DIVIDENDS.—Western Union Telegraph Company has declared a quarterly dividend of 1¼ per cent., being No. 137. It is payable January 15. A 1 per cent. dividend on the common stock of International Steam Pump, being the quarterly installment of the 4 per cent. dividend declared on that issue last spring, is payable January 2. The Columbus Edison Company has declared a semi-annual dividend of 3 per cent. on its preferred stock and a quarterly dividend of 4 per cent. on its common stock, payable January 2. The Twin City Rapid Transit Company has declared a quarterly dividend of 1¾ per cent. on the preferred stock, payable January 2, 1903. A dividend of $5 per share has been declared by the West Philadelphia Passenger Railway directors, payable January 1. Directors of the Philadelphia Union Passenger Railway Company have declared a dividend of $4.75, payable January 1. The directors of the United Railways Investment Company, of San Francisco, have declared a dividend of 1½ per cent. on the preferred, payable January 3.

MASS. ELECTRIC COMPANIES.—In 1901 the Massachusetts Electric Companies derived $777,841 in dividends from its sub-companies and "other income" brought the total income up to $819,158. The Companies' report will not show as large an income this year, but considerably more than sufficient to pay the 4 per cent. dividends on the outstanding Massachusetts Electric preferred stock, and during the present period of reconstruction this is all the management of the properties has cared to show. It has been estimated that it would require an expenditure of $10,000,000 to place the 800 odd miles of road in the Massachusetts Electric system in a position to be economically operated and show proper returns upon the invested capital. This plan is being systematically carried out, and it is estimated that it will require at least two years. During the past year the two leading properties of the Massachusetts Electric Companies carried 115,621,514 paying passengers and 2,112 cars covered 23, 436,247 car miles.

LOUISVILLE TROLLEYS.—It is understood the Louisville Railway directors will declare an extra dividend of 1 per cent. on the $3,500,000 of common stock in addition to the regular quarterly dividend of 1¼ per cent. and arrange for the distribution of $500,000 to $1,000,000 of new common stock to the old common holders at par, but with a payment of $50 a share to be credited to the stockholders out of the surplus. This will give the stockholders the new shares practically at $50, although the market price is 150. The money thus received will be used in building interurban lines, and it is understood a similar distribution of stock will be made every year for three years. The road's earnings are very large and equal to 10 per cent. on the common stock.

LONG ISLAND LIGHTING.—The Queens Borough Light and Power Company, which has a plant at Astoria, has absorbed the stock of the Hempstead Gas and Electric Light Company and it will take possession of that company's plant at Rockaway Beach.

TOLEDO-DETROIT TROLLEY.—The Toledo-Detroit Shore Line Electric road has been sold to the Grand Trunk and Clover Leaf roads for $1,500,000. The deal is said to enable the Everett-Moore syndicate to cancel all its obligations.

NEW JERSEY TROLLEYS.—The Interstate Railways Company has been organized, with a capital of $10,000,000, for the purpose, it is said, of acquiring and consolidating trolley roads of New Jersey south of Trenton.

Commercial Intelligence.

THE WEEK IN TRADE.—The retail distribution, according to *Bradstreet's,* now easily occupies the first position in the trade situation. During the week it was stimulated by colder weather and the advance of the holiday season. The latter caused it to expand largely. Wholesale trade is relapsing into the quiet usual at this, the stock-taking period. Building trades and other leading industries note a quieting-down usual at this season of the year. Great basic conditions, however, make for future prosperity. Railway earnings show an increase of 7.2 per cent. in November over the same month last year, thus marking a thirty-ninth consecutive monthly increase shown in the country's railways. The iron and steel industries alone show some symptoms of weaker prices for crude material, but this is stated to be more apparent than real, because demands for supplies are as pressing as ever and production has not, as yet, overtaken consumption. Heavier forms of finished material show no signs of weakness, fancy premiums being still paid on quick deliveries of plate and structural material. Two-thirds of the country's steel-rail production for next year has already been booked. In the copper market little change in the condition of affairs is noted. Various rumors were current of large purchases by consumers, but they were without foundation and had little effect upon the market. The last quotations were: Lake, 11.65c.; electrolytic and casting stock, 11.45c.; standard, 10.75c. The business failures for the week ending December 11, as reported by *Bradstreet's,* numbered 236, as against 185 the week previous and 233 the same week last year.

DEVELOPMENTS AT PORT HURON, MICH.—Mr. W. F. Davidson, secretary and treasurer of the Port Huron Light & Power Company, writes us as follows: Our company furnish lighting to about 150 well-built cottages located on the lake shore, five or six miles from our power house with an alternating, three-phase current, using single-phase for lighting. It is the writer's intention to investigate the feasibility of establishing in these cottages electric radiators or some heating device so that on cool nights and mornings they would be able to have heat, perhaps charging them what might be called a daylight power rate for the heat; at any rate, a low enough rate so it will be in the reach of people occupying summer cottages who come here from cities located in a warmer zone than this. This company is installing a 1,500-kw Curtis steam turbo-alternator, and the same is now being shipped from the General Electric (Schenectady) Works. We are having made for us by the Alberger Company, of New York, a surface condensing outfit to maintain 28 actual inches of vacuum continuously, and expect to demonstrate some fine economies with this outfit. We are also putting up independent building adjoining our large fire-proof power house, and will make this plant separate in every way from our present generating plant.

ELECTRICITY IN MINING.—It is stated that the coal companies in the Wilkesbarre region are adopting electricity as a motive power as fast as it is practicable. The latest is the Delaware and Lackawanna, which has made preparations to establish a power house at Hampton colliery in the Keyster Valley to furnish current to the sixteen collieries in that region for light and power. This departure will dispense with the services of about one thousand mules and an army of drivers and other employees. Oil lamps will disappear and light will be furnished by electricity. The cost of the plant will be $150,000. The Erie has also contracted to erect an electric plant at Old Forge not only to haul its cars and light its collieries by electricity, but also to run the hoists, pumps, drills, cutters and other mine appliances. The Lackawanna has for some time been experimenting with electrical drills and cutters in its Bellevue colliery and has found them to work in an eminently satisfactory manner. It has an electrical breaker at the Auchincloss colliery, Nanticoke, which has given the utmost satisfaction, and it is only a matter of a short time before electric breakers will be established throughout the company's entire system.

A 9,000-HP HYDRAULIC PLANT is to be constructed on the St. Joseph River at Twin Branches, between South Bend and Elkhart, Indiana, for the purpose of furnishing power for lighting and manufacturing use within a radius of 20 miles. The plant will be operated on 21-ft. head. There will be six generators of 1,000-kw capacity each. Four of these machines have already been ordered from the Westinghouse Electric & Manufacturing Company, Limited. They will be of revolving field type, 13,200 volts, three-phase, 60-cycle, 120 r.p.m. Each generator will be operated by five horizontal shaft turbines of 48 inches each. These machines will be built by the Triumph Manufacturing Company, of Springfield, O. There are to be two 125-kw Westinghouse exciters, each direct-connected to three 24-in. Triumph horizontal shaft turbines, 230 r.p.m. The Westinghouse Company will furnish the switchboard, which will be electrically operated by that concern's new type of oil switches. Sanderson & Porter are acting as contractors and engineers for the promoters of the St. Joseph enterprise—a New York and Western group of capitalists. The plant is expected to be in working operation next summer.

THE NEW YORK TUNNEL COMPANY was incorporated at Albany last week with a capital of $250,000. The New York directors are Herbert S. Brown, Shirly Onderdonk, Harold Nathan and Clarence S. Brown. John D. MacLennan, of Cleveland, is also named as director. This company will have, acording to Consulting Engineer William Barclay Parsons, the work of constructing a tunnel under the East River from Battery Park to Clinton Street, Borough of Brooklyn. This tunnel is the second section of the three the contracts for which have been let by the Belmont Company, now constructing the rapid-transit subway. The first section extends from Ann Street to Battery Park, and the third from Clinton Street, Borough of Brooklyn, to Atlantic Avenue, Flatbush. Mr. Parsons gave it as his opinion that the cost of constructing the second section would approximate from $4,500,000 to $5,000,000. The contract was let to Andrew Onderdonk. He is the partner of John B. McDonald in the Jerome Park Reservoir project.

THE CLEVELAND CLIFFS IRON COMPANY is about to install an electric power distribution system for operating mixers and blowers in its Gladstone (Mich.) plant. It has recently purchased from the Westinghouse Electric & Manufacturing Company two 75-kw, direct-current generators and eight 10-hp, direct-current motors. The Pioneer Iron Works, of Marquette, Mich., owned by the Cleveland Cliffs Company, will also be equipped with electrical apparatus, which will be used for the operation of mixers and blowers, as in the Gladstone plant. Apparatus recently purchased from the Westinghouse Electric & Manufacturing Company for the Marquette plant, includes ten 10-hp, direct-current motors and two 150-kw engine type generators to be direct-connected to two Westinghouse compound condensing engines. The company has also ordered a Baldwin-Westinghouse electric locomotive to be used for shifting cars in its yards.

MANUFACTURES now form one-third of the exports from the United States, a larger proportion than in any preceding year. The figures of the Bureau of Statistics for the ten months of the year for which data are now complete show that manufactures formed during that period 32.61 per cent. of the total exports of the country, while the highest percentaage in any preceding fiscal year was that of 1900, in which the exports of manufactures formed 31.65 per cent. of the total exports. In no other fiscal year have manufactures formed as much as 30 per cent. of the total exports. The figures of the ten months now available indicate that the total exports of manufactures during the calendar year 1902 will reach about $415,000,000, or more than in any preceding fiscal year, save in the exceptional year 1900, when the total was $433,000,000.

SHELBY ELECTRIC COMPANY.—Local daily papers at Shelby, Ohio, published recently the statement that the Shelby Electric Company was about to close a deal for the sale of its plant and business to the General Electric Company; the purchase price to be paid in three yearly installments and the factory to remain in the hands of the present directors during that period of time. General Manager J. C. Fish, of the company, has caused to be published a signed statement in which he denies that the General Electric Company made a proposition for the purchase of the plant. Certain other parties have offered to buy a block of the company's stock from some of the present stockholders.

THE MECHANICAL BOILER CLEANER COMPANY, Chicago, reports an order just received from the Cudahy Packing Company for seven cleaners, this making 65 cleaners installed in the plants of that company; also a duplicate order for 13 cleaners from the Fort Wayne Gas Company. The Mechanical Boiler Cleaner Company, owning all the Garrigus patents, and others, covering a floating skimmer, is doing a very large business with many of the best corporations in the country.

TELEPHONE WORK AT PIERRE, S. D.—The first underground cable system installed in the State of South Dakota is now being placed by the Capital City Telephone Co., of Pierre. Mr. W. S. Rowe, general manager, is quite busy making these extensive improvements. He is reconstructing the exchange and cabling all the central portion of the city. He is also installing an entire new central office equipment of the manufacture of the Eureka Electric Company, of Chicago.

TROLLEY FOR SOUTH AFRICA.—A certificate of incorporation of the Netherland Tramway Corporation has been filed at Bridgeport, Conn. The incorporators are Richard T. McKiniry and Charles T. Lark, of New York, and Louis B. Grant, of Brooklyn. The capital stock of the corporation is $3,500,000. It is said the corporation will operate tramways and other franchises in the Transvaal and Orange River Colonies, South Africa.

PRICE LISTS WANTED.—The Empire Manufacturing Company, of Franklinville, N. Y., have recently purchased the Citizens' Electric Light plant in that city. It is their intention to install a 100-hp engine and a 1,000-light incandescent dynamo. They want price lists, circulars and other trade literature.

EQUIPMENT FOR MONTEREY STREET RAILWAY.—Mr. A. W. McLimont, the chief engineer and general manager of the Monterey Street Railway Company, which concern, as previously noted in these columns, has acquired the existing mule tramways in the city of Monterey, Mexico, for ultimate conversion into an electric traction system about 70 miles long, when seen at the offices of the Federal Electric Company in the Washington Life Building, by a representative of ELECTRICAL WORLD AND ENGINEER, said: "In the first instance, 30 miles of lines will be converted into an electric road. The initial equipment of the power station will have a capacity of 1,350 horse power. It will consist of three 450 hp. cross-compound condensing Corliss engines, each for direct connection to 500 volt generators of 300 kw. capacity. The boiler plant will be in five units of 150 hp. each. In the construction of the track 60-pound T-rails and 70-pound girders will be used. For the present, the car equipment to be ordered will comprise 35 open bench cars and four freight cars. The cars will have double trucks. They will each be equipped with double motors of 38 horse power. They will also have air brakes. The trolley poles will be made of iron. The trolley wire will be No. 00. The power station and car house have been designed so as to permit of extensions. These buildings are now being constructed by the American electrical engineering and contracting firm of Mackin & Dillon, of Monterey. Steel beams, trusses, etc., will be used in their erection. Later on, we propose to install a storage battery system in connection with the power plant. No expense will be spared in making the road one of the most thoroughly modern and substantial systems. I am now getting estimates for equipment, etc., which I will take with me to Baltimore within the next few days for submission to Sperry, Jones & Co., who are financing the construction of the system, and the contracts will be let direct from Baltimore about the latter part of the current month. We hope to have the 30 miles of new road in active operation inside of 12 months."

SOME C. & C. ORDERS.—The C. & C. Electric Company, of 143 Liberty Street, New York, has secured an order from the Consumers' Ice Company, of Chicago, for a 125-kw engine type dynamo for both light and general power purposes. An order has also been received within the last few days for a 100-hp series-parallel equipment for operating a dock of the James Tregarthen Sons' Company, New York City. The Hall Signal Company, of Garwood, N. J., has requisitioned for an engine type dynamo of 40-kw capacity, which will be used for light and power. A fourth order has been obtained from the American Vulcanized Fibre Company, of Newark, Del., for a 50-kw belted dynamo. This machine will be employed for both light and power. Another repeat-order—the third—has been taken from the Smeeth Copper & Bronze Company, of Chicago, Ill., for a 40-hp motor to be utilized for power purposes. J. B. King & Co., of New Brighton, Staten Island, have called for two 7½-hp electric hoists. The C. & C. people will build the electrical portions. The Brooklyn Institute is to be supplied with two 18-hp slow-speed motors to be used for operating blowers. Other C. & C. contracts taken this week call for two 60-kw and one 40-kw generators for an apartment hotel now under construction up town, New York, and for one 50-kw and a 75-kw generator to be installed in a new Philadelphia apartment hotel. In both these instances the generators will be used for light and power. The Consolidated Dental Manufacturing Company, of New York City, has just ordered a 65-kw belt type dynamo for light and power use.

THE ELECTRIC CARRIAGE CALL COMPANY, 1402 Broadway, New York, has arranged for an installation of its system with the Hamburg-American Line, on the steamship *Deutschland*, for signalling at night at sea. Instead of numbers they are going to use letters which form the international code. This system for signalling will be visible five miles and will be the only system of its kind in operation. It is especially valuable on account of the record that is kept of all signals sent out by the perforated cards, which, after they are used, are dropped into a locked box, which is accessible only to those in authority. This system has been designed and supervised by Mr. Mortimer Norden, the general manager of the above-mentioned firm, which has also closed contracts with the Montauk Theatre, Brooklyn, Carnegie Music Hall, New York, and through its agent, the National Electric Supply Company, of Washington, it has installed four in that city.

700-KW PLANT FOR EASTON, PA.—The People's Light, Heat & Power Company's plant at Easton, Pa., is to be installed with a 700-kw equipment. The generators will be six in number—four of 150-kw capacity each and two capable of developing 50 kw each. These machines are being supplied by the Northern Engineering Company, Incorporated, of 95-97 Liberty Street, New York. There will be three engines furnished by the Harrisburg Foundry & Machine Works, of Harrisburg, Pa. Two will be of 400-hp capacity each and one of 175 hp. They will be of tandem compound type. Two of the larger generators will be direct-connected to each of the larger engines. The boiler plant is to consist of three units of 300 hp each. This part of the contract has been undertaken by the Sterling Company.

ELECTRIC MACHINERY COMPANY.—This concern, of Minneapolis, Minn., was recently formed with a capital stock of $125,000, of which $110,000 has been paid in. It will continue the manufacture of electrical machinery as started and developed by C. H. Chalmers and J. T. Boustead. Several well-known lumbermen and flour manufacturers of the locality are interested in the enterprise. It is now building a 300-kw generator to be direct-connected to a Corliss engine at 100 r.p.m. This is the largest built by the concern so far, but it is equipping its shops to handle almost anything up to 1,000 kw.

MACHINE TOOLS FOR ENGLAND AND SOUTH AFRICA.—The Niles-Bement-Pond Company, of 136 Liberty Street, New York City, are receiving considerable orders for machine tools at present from England and South Africa. The demand from the first-named country is for new model turret lathes, thread milling machines and adjustable multi-spindle drills, manufactured at the Pratt & Whitney (Hartford, Conn.) shops of the company. The requisitions from South Africa chiefly come from Johannesburg and call for heavy machines—lathes, planers and boiler-making tools.

EQUIPMENT FOR ARLINGTON CELLULOID PLANT.—The Arlington Manufacturing Company has let contracts for the extensive electrical equipment of its celluloid plant now under construction at Arlington, N. J. The generators will be supplied by the General Electric Company. Sprague motors will be used. The contract for wiring has been undertaken by the Electrical Construction & Supply Company, of 27 Thames Street, New York. The switchboard, motor panels, etc., will be supplied by the Northern Engineering Company; New York offices, White Building, Liberty Street.

IMPORTATION OF COAL.—The bulletin of the New York Edison Company says: Probably the largest single cargo of coal that ever crossed the Atlantic, or any other ocean, is that of 8,525 tons just received by the New York Edison Company from the mines of Cardiff, Wales. This is one of several cargoes ordered by the New York Edison Company during the time of the strike, thus insuring against the possibility of coal shortage, however great the local famine." This is a good evidence of the far-sighted policy of the company's management.

MORE YANKEE CARS FOR SOUTH AFRICA.—The East London (South Africa) Municipal Electric Traction system is to be extended. The existing equipment was manufactured in the United States. The Jackson & Sharp (Wilmington, Del.) plant of the American Car & Foundry Company, for which concern Dutilh-Smith, McMillan & Co., 25 Broad Street, are the export managers, have just received an order for cars.

PUBLIC CONTRACTS OPEN.—Proposals are invited for the construction of water works and an electric plant by Springfield, Tenn., until December 15. H. T. Stratton is mayor. The public works department of Nashville, Tenn., will purchase two additional boilers for the electric light plant. Mr. Emmet Snipes, secretary commissioners, Searcy, Ark., will receive bids until December 26 for the installation of an electric light plant.

LARGE BRAZILIAN HYDRAULIC PLANT PROJECTED.—The St. John Del Rey Mining Company, a British capitalized concern, with head offices in London, which carries on extensive mining operations in Brazil, has acquired considerable water power in the vicinity of its properties with a view to the erection of a large hydraulic plant intended for the furnishing of power to operate low-grade iron ore in large quantities.

ANOTHER MEXICAN TRANSMISSION LINE.—German Roth & Company, engaged in extensive gold and silver mining operations in the district of Temascaltepec, State of Mexico, are about to let contracts for the construction and equipment of a hydraulic plant on the Rio Verde. Their concession permits of the utilization of 2,000 litros of water per second.

PENNSYLVANIA ELECTRIC RAILWAYS.—Superintendent Brown, of the Pennsylvania State Bureau of Railways, in his annual report, just made, criticises electric railway methods; says the various companies are overcapitalized; in fact, to twice their cost, and urges that New England's plan of supervising stock issues be adopted.

TO LIGHT CARTERET (N. J.) PHOSPHATE PLANT.—The International Phosphate Company's new plant at Carteret, N. J., is to be equipped with a 13-in. by 12-in. Harrisburg simple engine for direct connection to a 50-kw C. & C. engine type dynamo. This outfit will be used for lighting purposes.

THE STERLING ELECTRIC COMPANY, of Lafayette, Ind., has contracted to erect a telephone plant at Durban, a city of 100,000 inhabitants, in the colony of Natal, South Africa.

General News.

THE TELEPHONE.

SAN FRANCISCO, CALIF.—B. R. Fox has been granted a telephone franchise for a line to cover Azuza, Calif., and vicinity.

SAN FRANCISCO, CALIF.—The Direct Line General Telephone Company, with a capital stock of $2,500,000, has been incorporated. The directors are J. Finch, A. G. Andriano, W. T. Hess and others.

SAVANNAH, GA.—The Georgia Telephone and Telegraph Company is adding 200 new telephones to the local system.

AUGUSTA, GA.—The Southern Bell Telephone Co. has filed the necessary bond and received permits for beginning the work of installing its underground system of wires and conduits.

AUGUSTA, GA.—The city council has voted that the Strowger Telephone Company and the Bell Telephone Company be asked for bids, provided there is no contract with the Bell, for the city business. The bids will be called for the latter part of December. The Strowger Company has expended during the past few months $65,000 in various improvements.

MOSCOW, IDAHO.—Telephone lines will be built from Moscow to the outlying county. The mayor has the matter of bids and other work in charge.

KANKAKEE, ILL.—The council has granted a franchise to the Interstate Independent Telephone & Telegraph Company, a branch of the Illinois Telephone Company.

MOLINE, ILL.—The Independent Telephone Company will have its new Moline exchange ready to open for business about Jan. 1. About 450 telephones will be connected and ready for use by that time.

CHICAGO, ILL.—Thirty-nine persons and business firms have been allowed by Judge Tuley to become co-complainants in the suit brought by the Illinois Manufacturers' Association against the Chicago Telephone Company to enjoin the latter from charging more than the franchise rate of $125 a year for its service.

ELKHART, IND.—The Home Telephone Company, of Elkhart County, has decided to improve its plant at an expenditure of $30,000.

MARION, IND.—The commissioners of this (Grant) County have granted the Citizens' Co-operative Telephone Company, of Fairmount a franchise to operate lines throughout the county. By an agreement with the Central Union Company the new concern has the use of its lines to Marion subscribers.

LOGANSPORT, IND.—The Logansport Home Telephone Company gave a reception recently to hundreds of visitors, exhibiting the plant and explaining the working of the modern system. Managers of telephone companies from all over the country were present and many others who are interested in the business of telephones.

INDIANAPOLIS, IND.—The Louisville Home Telephone Company, with a capital of $75,000 represented in Indiana, principally in the city of New Albany, has complied with the State law by filing articles of incorporation and securing a license. The capital stock of the company, as represented in the two States, is $1,500,000.

KOKOMO, IND.—The Independent Telephone Company, of this city, has announced an advance in rates for private houses from $1.25 to $1.50 per month. This action is likely to precipitate a renewal of the rate war between the Bell and independent companies. The Bell Company has continually charged $1.50 per month for residences and in order to secure its hold has declared its intention to reduce the rate to $1.25.

TERRE HAUTE, IND.—The Kinloch Telephone Company, of St. Louis, Mo., has asked for a franchise for a long-distance line from the Illinois State line to Terre Haute. The company's line is completed to Casey, Ill., and the company wants to cross into Indiana and connect with the Citizens' Company at Terre Haute, thus establishing direct connection with the long-distance system of the independent lines through Indianapolis.

PETERSBURG, KY.—The Boone County Telephone Company will extend its lines to Bellevue and Rabbi Hash.

JEFFERSONVILLE, KY.—Representatives of the Louisville Home Telephone Company are endeavoring to organize an independent telephone company in this place. The Home Telephone Company has a franchise granted some years ago, but no work was ever done.

PORTSMOUTH, KY.—The Portsmouth Telephone Company is preparing to build lines to Springville, Fullerton, Malonton, Argentum, Lynn, Warnock and Tygarts Valley. At Warnock connection will be made with the Greenup and Grayson lines.

DETROIT, MICH.—The Tamarack Telephone Company is building two additional lines between Stockbridge and Dansville.

JACKSON, MICH.—The People's Telephone Company, of this city, has been taken over by the Citizens' Company, of Grand Rapids, and its name changed to conform to that of the latter.

MINNEAPOLIS, MINN.—Long distance telephone service was opened between this city and Winnipeg, Manitoba, on Dec. 2. The new lines run through Fargo, Grand Forks and Neche, the stretch from Neche to Winnipeg having been constructed by the Canadian company. The distance is 500 miles.

BUFFALO, N. Y.—The Independent Union Telephone Company has been incorporated with a capital of $200,000.

TYRONE, N. C.—The Polk County Telephone Company, with a capital of $5,000, has been chartered by Thos. C. Mills and others.

OTTAWA, OHIO.—The Farmers' Mutual Telephone Company has applied for a franchise in Ottawa and the petition is signed by over 300 people who will become subscribers.

CINCINNATI, OHIO.—Judge Smith has decided that telephone companies have the right to erect telephone poles in sidewalks on a permit from the city if there is no special injury to property owners in the way of cutting off light or air.

FOSTORIA, OHIO.—The farmers about Fostoria are making so many applications for telephones that the Federal Telephone Company can fill only about one-fourth of them. The company will extend its lines and enlarge its switchboard.

BOWLING GREEN, OHIO.—The Ticker Independent Telephone Company, reaching some twenty towns in the interior of the State, will build a line to connect with the long distance system of the Cumberland Telephone & Telegraph Company.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has given a mortgage for $200,000 to the Cincinnati Trust Company to cover bonds of the same amount. A portion of the money will be used for the completion of the system. F. W. Hughes is president and F. W. Whitaker secretary of the company.

CLEVELAND, OHIO.—The gross earnings of the United States Telephone Company for the month of September were $27,006. Expenses and taxes were $14,660, leaving net earnings of $12,346. The monthly interest is $7,771, leaving surplus for stock of $4,576. At this rate the company is earning two per cent. on the stock outstanding.

MELMORE, OHIO.—Farmers of Melmore, Sycamore, Plankton, Poplar and Lykins have organized a company for the purpose of establishing rural telephones through the district. The main exchange will probably be established at Plankton. Graffton Baker, of Melmore, is president and Harvey Close, of Plankton, secretary-treasurer of the company.

BOWLING GREEN, OHIO.—The Federal Telephone Company has completed an examination as to the improvements necessary to place the exchange of the Wood County Telephone Company in first class shape. The capacity of the plant will be nearly doubled and lines will be extended to Rudolph, Portage, Mermill and other towns in this vicinity.

ASHLAND, OHIO.—The circuit court has granted a franchise to the Central Union Telephone Company to install its system in Ashland. The field has long been in the hands of the independent and the Bell Company has failed repeatedly to secure a franchise from the village council. The company was defeated in both the probate and common pleas courts.

CLEVELAND, OHIO.—The Cleveland Telephone Company is placing electric alarms on all pay stations. The alarm rings in the room of the person in charge of the building, in case an attempt is made to tamper with the contents of the toll box. The company has experienced great trouble from pay stations being rifled. The money lost is not large, but the telephone is usually thrown out of service.

CLEVELAND, OHIO.—H. R. Newcomb, chairman of the Everett-Moore banker's committee states that the syndicate is planning to pool the entire assets of the Federal Telephone Company and put up a collateral trust bond issue to fund all its debts. These bonds would likely be taken by some of the creditors of the syndicate for the money due from the Federal Company, and by the Everett-Moore syndicate itself for money which will be advanced to place the affairs of the company in good shape.

CINCINNATI, OHIO.—The Cincinnati Telephone Company has been incorporated with $50,000 capital stock to construct and operate lines between this city and Lebanon, extending through Hamilton, Butler and Warren Counties. An effort will also be made to establish an independent exchange in Cincinnati. Incorporators: Robert W. Seebaum, R. C. McCracken, Sheldon Browne, J. S. Nowotney and James P. Hughes.

PICKENS, S. C.—It is reported that the Southern Bell Telephone Company has purchased the local independent system.

CHATTANOOGA, TENN.—A franchise will likely be granted to Annie McElroy Brett for a new telephone system with the right to place the wires underground. The grantees guarantee that $100,000 shall be spent in the city within six months from the final passage of the ordinance. Mrs. Brett also owns systems in Detroit and in El Paso, Tex.

PARIS, TEX.—The Citizens' Telephone Company, of Paris, has increased its capital stock from $120,000 to $150,000.

ABILENE, TEX.—The Northwestern Telephone Company, capital $75,000, has been incorporated by W. G. McWright, D. M. Howard, G. R. Loveless and others.

McKINNEY, TEX.—The Roland Local Telephone Company, capital stock $5,000, has been incorporated by C. T. Lewis, C. H. Farnsworth, J. R. Coggins and others.

SALT LAKE CITY, UTAH.—The Utah Home Telephone Company has been granted a franchise in this city. The grant limits the rates to be charged to $48 per annum for business telephones and $30 per annum for residence instruments on individual metallic circuits.

OGDEN, UTAH.—The Home Telephone Company has petitioned for a franchise to install and operate a telephone line in Ogden. The Rocky Mountain Bell Telephone Company has asked the council to extend its franchise in accordance with the terms proposed in an application two months ago, and which was at the time rejected by the council.

NORFOLK, VA.—An injunction has been issued against the Hampton, Va., Telephone Company to prohibit the company from discontinuing its service in Norfolk in connection with the Southern States Telephone Company. This is said to be the beginnning of a long fight between the Bell Company and the local exchange.

ODESSA, WASH.—J. A. Willis, of Willis, Adams County, has applied to the town council for a franchise to operate a telephone system in this place.

CITY OF MEXICO, MEX.—A proposition to establish and operate an extensive system of telephones in the City of Mexico has been made to the municipal council by M. G. Ribson, general manager of the Mexican Gas and Electric Light Company of the City of Mexico.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—The Mutual Electric Light Company, which operates a steam plant in San Francisco, is now procuring estimates from manufacturers of steam engines and electrical apparatus for the equipment needed for the new power house which is to be erected at the corner of Stewart and Folsom Streets. The initial installation will probably consist of two 1,500-kw two-phase generators, each direct-connected to a horizontal automatic engine. Oil fuel will be used in the new station. The new underground conduit system will be thoroughly up-to-date and the present distributing system will be remodeled on changing from single to two phase.

SAN FRANCISCO, CALIF.—A. M. Hunt, of San Francisco, is engineer for the capitalists who intend to install a 10,000-hp electric power plant on the American River near Placerville, Cal. He has returned from an inspection of the water power sources. An interested party says that the reports that the plant would be installed in connection with the new company headed by H. H. Griffiths, which has commenced the construction on a new street railway system in Stockton are incorrect. It is possible that a 60-mile transmission line might be built to that place if there were a sufficient demand for electric power for railways or other purposes, but, at present, no Stockton railway company has any interest in this project. A large portion of the output of the initial installation will be required for running operations not very far from the plant.

BARNESVILLE, GA.—The city will soon be held on a bond issue of $6,000 for an electric light plant.

LEWISTON, IDAHO.—The electric light company is building a new station and will install a 500-kw Westinghouse generator. The company is expending about $50,000 in rebuilding its system in Lewiston.

PANA, ILL.—For the first time in two months the streets of Pana were lighted on the night of December 1. The lighting question has not been settled between the council and the light plant, but the lights were paid for by the manager of a place of amusement for the purpose of showing the people the way to the play that was given on that night. When the play was over darkness again fell over the city. At present there seems no prospects for lights.

EDWARDSVILLE, ILL.—The city council and the Edwardsville Electric Light & Power Company have at last arrived at an agreement in regard to a franchise for street and commercial lighting in the city. Since the expiration of the contract with the local company on October 14, the city has been in darkness, the authorities and company being unable to agree upon terms for an extension. The street lights were turned on December 9 by the company and will be continued, the franchise being given for a period of ten years.

INDIANAPOLIS, IND.—The Modern Light, Heat & Power Company, of Indianapolis, has been incorporated. The capital stock is $10,000. C. A. Johnson heads the board of directors.

MARTINSVILLE, IND.—L. K. Davis, of Indianapolis, has purchased the electric light and gas plant of this city. Both plants will be repaired and improved, and $50,000 worth of new machinery installed.

RICHMOND, IND.—The friends of the municipal electric-lighting plant which has been in operation here only a few months are well pleased with the showing made. They claim that as soon as the consumers can all be connected there will be an income sufficient to maintain the plant without the street lighting which is now done by a private company at an expense of $15,000 a year. When this is turned into its coffers the municipal plant will speedily pay for itself, they say.

ELKHART, IND.—Another legal battle for possession of valuable rights on the St. Joseph river has begun in the Federal Court between the St. Joseph Navigation Company and the St. Joseph and Elkhart Power Company. The latter company is constructing a dam at Elkhart for a large power station to generate electricity for factory use. The former company seeks to enjoin the construction of the dam on the ground that the river is navigable and that no consent has been obtained from Congress to dam the river.

PLATTSBURG, MO.—The Plattsburg Light and Power Company has been incorporated to supply electric light, power and heat, with a capital stock of $40,000. The incorporators are M. J. Trimble, Claude C. Funkhouser, Joel Funkhouser and Alice H. Funkhouser.

ST. LOUIS, MO.—The Mississippi Valley Trust Company filed a deed December 3, conveying to the Union Electric Light and Power Company a lot fronting on Lewis Street for $100,000. The sale was made several months ago and the site is now being improved with a light and power plant.

ST. LOUIS, MO.—Bids were opened at the meeting of the board of public improvements Dec. 9 for the construction of two municipal lighting plants—one at the city hall and the other at the insane asylum. The lowest totals make the cost of the city hall plant, if the lowest bids are accepted, $31,103 and of the insane asylum plant $10,860.11.

JEFFERSON CITY, MO.—In the Cole County Circuit Court recently Robert W. Ray, of Canton, filed a suit for an injunction against State Auditor A. O. Allen to prohibit that official from registering $10,000 of bonds issued by the city of Canton for the construction and operating an electric light plant. T. L. Durke and others are the plaintiffs in the suit. They contend that the special election which was held on September 23, and at which the proposition carried, was not legally held in that the ordinance was not signed by the mayor when the election was ordered, nor was notice given in newspapers as required by law. The petition also attacks the validity of the law of the last legislature which allows cities of the class of Canton to vote bonds for electric light and water works purposes and declares this law is in violation of the Constitution in that it has two subjects in the title, and for other reasons.

ELIZABETH CITY, N. C.—The Berkley Railway and Light Company has purchased the local electric light plant and proposes to construct an electric railway, light and sewerage system at once.

GERMANTOWN, OHIO.—The council has authorized the mayor to issue $8,000 bonds with which to enlarge the municipal lighting plant.

NORTH LEWISBURG, OHIO.—An electric light plant in this place is one of the improvements hoped for. There is an opportunity for such an enterprise.

FINDLAY, OHIO.—The Toledo, Bowling Green & Southern Traction Company will increase the capacity of its Findlay power station to provide more current for city lighting. The company has announced that it will spend $12,000 in improvements to the lighting plant.

YOUNGSTOWN, OHIO.—The Youngstown Consolidated Gas & Electric Company is preparing to replace all the arc lamps in the city with new ones of the latest pattern. Four hundred lamps of the enclosed type will be purchased.

COLUMBUS, OHIO.—The Indianola Heating & Lighting Company has organized as follows: W. E. Swisher, president; W. H. Sharpe, vice-president; Paul De Long, secretary-treasurer. The above, with C. L. Kurtz, George L. Gugle, W. V. Baker and Joseph Slater, are directors.

OTTAWA, OHIO.—The Ottawa Electric Light Company has submitted to the town a proposition under which it will lease its plant. It provides that the town shall assume charge of the plant and pay a monthly rental of $200 for a period of ten years, after which the plant may be purchased by the town for $15,000. The matter is under consideration.

READING, PA.—Electricity will be introduced into the mills of the Reading Iron Company to provide power as well as light on a large scale. Plans for a large plant have been prepared.

BEAVER, UTAH.—It has been decided to build a large reservoir at Minersville canon for power and irrigation purposes. Senator A. B. Lewis, of Beaver County, has bought a large tract of land, finished preliminary surveys and will build a dam 64 feet high, giving a 154-ft. fall of water. Electric power is to be used for electric railways, light and manufacturing plants. Senator Lewis has applied for 4,000 acres of land to be reclaimed by irrigation and for the site of the plant. About 800 horse-power will be obtained.

RICHMOND, VA.—The Virginia Passenger and Power Company has bought machinery for 5,000 additional horse-power for its various power plants. The new power house will be completed by May 1.

ETTRICK, VA.—It is said that the power and manufacturing plant of the Ettrick Manufacturing Company will pass into the possession of the Virginia Passenger and Power Company as Geo. E. Fisher, of New York, the purchaser of the Ettrick plant which was sold under a deed of trust, is a large stockholder in the Virginia Passenger and Power Company, of Richmond. The price paid by Mr. Fisher was $66,100.

NEW CUMBERLAND, W. VA.—The New Cumberland light plant has been sold at trustees sale for $2,000 to Judge Campbell, Wm. Marquet, A. F. Wilkins and James Porter. The new owners will operate the plant and furnish light to the village.

MARTINTON, W. VA.—The Pocahontas Water, Light & Power Company has been incorporated with $25,000 capital stock by J. W. Price and others, of Martinton. The company proposes to furnish light and power in Martinton, Durbin and Barton.

TAMPICO, MEX.—A new electric light company has been organized at Tampico. It is composed of local capitalists.

AMECA, MEX.—A company of Mexican capitalists has been formed for the purpose of establishing an electric light plant in the city of Ameca, in the State of Jalisco. The power for the proposed plant will be derived from a waterfall situated on the Estanzuela hacienda, as noted in our issue of Dec. 6. The company has entered into a contract with the municipal authorities of Ameca to supply that city with lights.

THE ELECTRIC RAILWAY.

ROME, GA.—J. L Bass and R. A. Denny have gone North to complete financial arrangements for extending the electric railway to Lindale, a new village owned by the Massachusetts Mill Company.

COLUMBUS, GA.—On January 1 the Columbus Railroad Company will increase the wages of motormen and conductors from 12 to 13 cents per hour. A 10 per cent. bonus is also paid for good service and freedom from accident.

ANDERSON, IND.—The city council has extended the franchise of the Union Traction Company fifty years. The company has appropriated $100,000 for the building of new car shops in this city. The capacity of the power house will be increased two-thirds, the machiney having already been purchased.

SHELBYVILLE, KY.—The Louisville, Anchorage & Pewee Valley Railway has applied for a franchise to build its line through this place. Some of the grading has already been completed and contracts for other work are being placed. Percy Moore, of Louisville, is at the head of the company.

BALTIMORE, MD.—It is reported that the Chesapeake Beach Railway (steam) between Washington and Chesapeake Bay may be converted into an electric line. David H. Moffatt, of Denver, Col., is the owner.

VICKSBURG, MISS.—The Yazoo and Mississippi Valley Railroad is planning to install an electric light plant in the Vicksburg shops.

HIGH POINT, N. C.—It is reported that a company of outside capitalists will build a factory here next spring for the manufacture of trolley cars.

AKRON, OHIO.—The Northern Ohio Traction Company's railway department earned $52,310 during November, a gain of $13,304 over the same month last year.

CLEVELAND, OHIO.—The November earnings of the Elgin, Aurora & Southern Traction Company were $28,607, a gain of $6,068 over the same month last year.

CLEVELAND, OHIO.—The Cincinnati, Dayton & Toledo Traction Company is making large gains in its earnings. The gross for November was $38,315, a gain of $6,759.

GREENVILLE, OHIO.—The Dayton & Northern Traction Company will build a freight station at this point and a franchise has been granted for necessary turnouts.

ALLIANCE, OHIO.—The Stark Railway Company is making surveys for its extension from Sebring to Salem. The road is practically completed from Canton to Alliance and Sebring.

CLEVELAND, OHIO.—The Cleveland, Painesville & Ashtabula Railway Company is closing contracts for the equipment of the road and power house. Plans for the power station were prepared by J. B. Perkins, of Toledo.

PORTSMOUTH, OHIO.—The Portsmouth Street Railway & Electric Light Company is preparing plans for a new power station. While the matter has not been definitely decided it is probable that the plant will be erected in the spring.

TOLEDO, OHIO.—The Toledo Railways & Light Company is erecting a new 5,000-hp engine built by the Allis-Chalmers Company. It is of the vertical cross-compound condensing type and is direct connected to a 2,000-kw Westinghouse generator.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company, which has bought up the Zanesville Street Railway Company and the Zanesville Electric Company, has applied for a 25-year blanket franchise covering the grants of the former companies.

MARIETTA, OHIO.—The council has granted a franchise to the Parkersburg, Marietta & Interurban Railway which will enable it to extend its tracks to and over the new Ohio River bridge. The extension to the West Virginia side will be made as soon as possible.

TOLEDO, OHIO.—The United States Construction Company is offering for sale $25,000 worth of the stock of the Toledo, Columbus, Springfield & Cincinnati Railway Company. The company is doing the construction work for the road and desires to realize on a portion of the stock.

COLUMBIANA, OHIO.—The O. K. Oil & Gas Company is negotiating with the Youngstown & Southern Railway Company looking to the erection of the railway power house near this city with a view to using gas from the company's wells as fuel. The proposition is being considered with favor.

LEAVITTSBURG, OHIO.—A number of citizens have signed a petition asking the county commissioners to revoke the franchise of the Pennsylvania & Mahoning Valley Railway on account of the failure to operate cars over the Leavittsburg extension. The road is completed but the company claims it is being held up by a railroad crossing.

CARTHAGE, OHIO.—The village council has declined to grant a 25-year franchise to the Cincinnati Interurban Company except on a basis of 5 cent fare to Fountain Square Cincinnati and universal transfers from that point. The company will not consider the proposition. The citizens have organized to resist any attempt to lay the tracks at night.

CLEVELAND, OHIO.—Directors of the Aurora, Elgin & Chicago Traction Company have voted to pay the first dividend on preferred stock on December 17 of three per cent. The company will not be able to pay this wholly out of the earnings of the road, since it has been in operation only for a short time. The gross earnings for the month of November were $16,594.

TOLEDO, OHIO.—The Toledo, Ft. Wayne & Southern Railway Company will soon be incorporated in Ohio to build a line from Toledo to Indianapolis by way of Ft. Wayne, Huntington, Elwood and Marion. The promoters are D. W. Jones and L. A. Smart, of Cleveland, W. H. Ogan, Tipton, Ind., and Dr. J. F. Spaunhurst, of Indianapolis.

ATHENS, OHIO.—A new company has been formed to take over the franchises secured some time ago for a line from Athens to Nelsonville. The officers of the new company are J. J. Woodward, president and general manager; D. H. Siggins, vice-president; L. M. Riddlesperger, treasurer, and H. H. Haning, secretary. The first three mentioned live at Warren, Pa.

FINDLAY, OHIO.—Farmers in this county appear to have organized to make trouble for the Western Ohio Railway Company, which is preparing to build its line from Lima to Findlay. None of them will sell right of way except at a certain figure which, needless to say, is exorbitant. The company has decided to break the combination by bringing condemnation suits.

CLEVELAND, OHIO.—The Northern Ohio Traction & Light Company, which is to succeed the Northern Ohio Traction Company, has been incorporated with a temporary capital stock of $10,000, by J. R. Nutt, W. R. Whitney, H. J. Crawford, C. E. Sanders, and V. J. Terrell. The majority of the stockholders of the old company have agreed to the change, which will be effected December 29.

SANDUSKY, OHIO.—There is a report that the Sandusky, Bellevue, Monroeville & Norwalk Railway project will be revived in the near future. Considerable work of grading and building of culverts was done about two years ago, but many of the franchises have expired. The new promoters are said to have ample capital to complete the road as originally proposed. The road was to have connected Sandusky, Norwalk, Chicago Junction, Plymouth and Mansfield.

TOLEDO, OHIO.—Surveys have been started on the new line which the Toledo, Bowling Green & Southern Traction Company proposes to build between Bowling Green and Toledo, relieving the company of the necessity of entering the city over the tracks of the Toledo & Maumee Valley Railway from Perrysburg. The new short cut will be 23 miles long and will touch the towns of Sugar Ridge, Dunbridge, Dowling, Lime City, and besides drawing from these towns the company will save about thirty minutes on the running time to Bowling Green.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate will announce the financing plan of the Ohio Central Traction Company about January 1. The road is a consolidation of the old road of the same name and the new Mansfield, Crestline & Galion Railway. The entire line extends from Bucyrus to Mansfield, a distance of 35 miles. It will be bonded at $700,000 with stock of the same amount. The road is now fully in operation and next year it will be connected with the Cleveland, Elyria & Western Railway by a connecting link from Mansfield to Wellington.

WELLSBURG, W. VA.—The council has granted a franchise through town to the Pan Handle Traction Company. The Wellsburg, Steubenville & New Cumberland Traction Company has applied for a franchise to enable it to build up the West Virginia side of the Ohio river to Holliday's Cave.

THE AUTOMOBILE.

AUTOMOBILE SCHOOL.—It is reported that a school is to be established in Philadelphia for instruction in the art of handling automobiles. A full and thorough course is to be given, at the end of which diplomas will be granted to students passing examinations.

AUTOMOBILE MAIL ROUTE.—What is said to be the first rural automobile mail route in the United States has been established between Portland and Pennville, Ind. It covers a distance of twelve miles. Patrons of the line are served twice a day, the machine making two trips each day. The government officials at Washington are interested in the experiment as it is expected that many automobile mail routes will be established in the near future.

NEW INDUSTRIAL COMPANIES.

THE ROSEMONT ELECTRIC TRANSMITTER COMPANY, of New York, has been incorporated; capital, $250,000. Directors: Herman Schwarz, Julius Rosenberger and A. H. Schwarz, New York.

THE INDEPENDENT INCANDESCENT LAMP COMPANY, of St. Louis, Mo., has been incorporated with a capital stock of $20,000. The incorporators are Harry M. Coudrey, Walter L. Gilliam, Walter Ennes, James A. Gerr and B. G. Tremaine.

OBITUARY.

MR. A. C. BARNEY, member of the street car manufacturing firm of Barney & Smith, of Dayton, Ohio, died recently of heart trouble at Monte Carlo, where he collapsed on arrival in the railroad station from Paris, while on a trip for his health.

MR. C. L. PULLMAN.—The death is announced of Mr. Charles L. Pullman, a brother of the late George M. Pullman, of sleeping car fame. He was himself an inventor of no mean ability and was well known in the electric street railway field.

CHARLES H. PINKHAM.—Charles H. Pinkham died in New York city last week after a brief illness. He was born in Salem, Mass., fifty-three years ago, and came to New York when seventeen years old. In 1888 he founded the Bank of Harlem and became its first president. This institution was later merged with the Hamilton Bank, 125th Street. He was at one time executive agent for the Equitable Life Assurance Society. At the time of his death he was general manager of the Bay State Electric Light, Heat and Power Company, with offices in Boston. Mr. Pinkham was a member of the Lenox Avenue Unitarian Church and of the New England Society, the Colonial Club, the Unitarian Club, and the Harlem Club.

MR. JOHN VAN HORNE, ex-vice-president of the Western Union Telegraph Company, died at his home in Pewee Valley, a suburb of Louisville on December 13, aged 75 years. He was born at Centreville, N. J., 1827, became an operator and rose rapidly in the early telegraph service. He was made president of the Southwestern Telegraph Company within the Confederate lines during the period covered by the Civil War. When the telegraph consolidation took place in 1866 under Western Union he became general superintendent of the Southern Division. and a member of the board of directors. In 1878 he became vice-president. His latest work while connected with the Western Union Company was the charge of the Contract Bureau, the Free Service Bureau, Electrical Department, Bureau of Statistics, etc.

PERSONAL.

MR. ANDREW CARNEGIE has returned to this country in good health and spirits, altogether recovered from his late illness.

MR. FRANK J. SPRAGUE is home from Europe, where he has been taking a brief vacation and studying the electric railway situation.

MR. A. FREDERICK COLLINS will deliver a lecture on "Wireless Telegraphy and Telephony" before the Brooklyn Institute, Jan. 23, 1902.

COUNT CORRADO EMO-CAPODILISTA, of Milan, Italy, is in the United States for the purpose of making a study of the electrochemical industry as developed here.

MR. J. W. PETERSON.—The Electrical Equipment Company, of Chicago, announces that J. W. Peterson has been elected president to fill the vacancy made by the withdrawal of Mr. J. Holt Gates.

MR. F. W. WILLCOX, of the General Electric Lamp Works at Harrison, N. J., is to lecture this week, on the 16th, in Brooklyn, N. Y., before the Modern Science Club, on the manufacture of incandescent lamps.

MR. J. CUSTANCE BENNETT, of London, England, who is actively connected with various electrical interests in that country, has been visiting the United States for some weeks past. He sailed for home this week to arrive Christmas.

MR. J. HOLT GATES has withdrawn from the Electrical Equipment Company, of Chicago, of which he was president, and will conduct business hereafter as J. Holt Gates & Company, with offices at 927 Monadnock Block, doing a contracting business.

MR. HENRY HOPKINS, superintendent of city street lighting at New Haven, Conn., has a neat little article in the local *Palladium* showing how valuable street lighting is, if efficient, in promoting the welfare and prosperity of a city and its inhabitants.

MR. FRANZ MEYER, Ph.D. has opened an office as consulting metallurgical and chemical engineer at 88 Broad Street, New York City. He will also make a specialty of negotiating the sale in this country and abroad of patents and inventions relating to the art.

MR. JOHN S. SEYMOUR, of Seymour, Seymour & Harmon, formerly U. S. Commissioner of Patents, has contributed to the current *Yale Law Journal* a pithy and most interesting article on patents, in which the subject is dealt with in a masterly manner.

MR. F. E. DRAKE, for two years past general manager of the Union Elektricitäts Gesellschaft, of Berlin, has just returned to this country after closing a very successful engagement. He proposes to stay permanently in this country, where he has a host of friends and many influential connections.

SENATOR O. E. HARRISON, of Greenville, Ohio, was in Chicago during the past week, during which time he visited the plant of the Stromberg-Carlson Tel. Mfg. Co. It is understool that Mr. Harrison is interested in an entirely new telephone enterprise about which more information will be published later.

MR. JAMES S. PEARCE has been appointed master mechanic of the Scioto and Cincinnati Divisions of the Norfolk & Western Railway Company, with headquarters at Portsmouth, Ohio. Mr. Herbert T. Herr has been appointed master mechanic of the Eastern General Divison, comprising the Radford, Shenandoah and Norfolk Divisions, with headquarters at Roanoke, Va.

MR. E. J. LAVENS, formerly connected with the General Incandescent Arc Light Company, will assume entire charge on January 1 of the panel board, switchboard and switch departments of the Bossert Electric Construction Company of Utica, N. Y. The development of this well-known business affords an excellent opportunity for the well-known experience and ability that Mr. Lavens is known to possess.

MR. J. J. RUTLEDGE, one of the largest and most successful operators in the Klondike is now in New York for the purpose of placing contracts for considerable machinery, including electrical equipment. Mr. Rutledge has been granted a concession by the Canadian government for the dredging of the entire length of the 40-mile river where gold was first discovered in the Klondike regions. He is a guest at the Hotel Manhattan.

MR. R. L. WARNER.—At the regular meeting of the New England Railroad Club, at the Pierce Hall, Boston, on December 9, a paper on "Electrically Driven Shops" was presented by Mr. Robert L. Warner, Boston sales manager of the Westinghouse Electric & Mfg. Co. Mr. Warner's paper was illustrated by a large selection of stereopticon views showing many examples of the application of direct-current and induction motors to the driving of machine-shops tools and other apparatus.

MR. W. MANDELICK, who was formerly connected with the Sprague Electric Company and was later private secretary to Mr. E. H. Johnson, has been for two years past with Mr. C. T. Yerkes in London and has now become secretary for the Yerkes underground traction interests in London. He is now spending a few weeks in this country at the holiday season and will return to London early in the new year. Mr. Mandelick is making very rapid advancement for so young a man, much to the pleasure of his many friends in America.

MR. CHARLES E. WADDELL, of Asheville, N. C., is on a visit to New York in connection with an important water-power electrical generating plant now being installed near Asheville. It is thought by those interested that in a short time the western section of North Carolina will become an important manufacturing region owing to the abundance of water power and availability of labor for textile mills. Mr. Waddell is also electrical engineer of the Vanderbilt Biltmore estate, the several electrical plants of which he has recently reconstructed.

MR. PHILIP W. MOEN has resigned as second vice-president of the American Steel & Wire Company. He graduated from Yale and entered the business after several years of study. He was made general superintendent and assistant treasurer and in 1891 he became general manager and treasurer, which offices he held until the Washburn & Moen Mfg. Company, with its $4,000,000 capital stock, sold out to the American Steel & Wire Company in 1898. Mr. Moen was made a director and third vice-president of the consolidation and afterward was promoted to second vice-president. He was manager of the Eastern division of the company's business.

MANDELICK-SQUIRE.—Miss Marie Antoinette Squire, the daughter of Mr. and Mrs. Levi Henry Squire, of New York City, and Charles Edward Mandelick, were married this week at All Angels' Protestant Episcopal Church, Eighty-First Street and West End Avenue. The ceremony was performed by the Rev. Dr. S. Delancy Townsend. Mrs. John H. Flagler, sister of the bridegroom, was matron of honor, and Miss Helen Maude Mabley, maid of honor. William C. Mandelick was best man, and the ushers were Henry W. Stackhouse, William J. Beggs, H. W. Abbott, and Clayton Mayo. A small reception followed the ceremony. The bridegroom has been for many years in the electrical field.

MR. C. H. MACKAY.—A telegram from San Francisco of December 12 says: The commercial bodies of this city have held a reception at the Palace Hotel in honor of Clarence H. Mackay and others of the management of the Commercial Cable Company who are to see the laying of the new cable to Honolulu. Governor Gage represented the State, and Mayor Schmitz was present on behalf of the municipality. G. G. Ward said: "The length of this cable will be three and one-half times greater than any Atlantic cable. When this shall be completed our system will reach from England and France to China, three-fourths of the distance around the globe. And I venture to predict that we shall be able to beat 'Puck's' prophecy of girdling the earth in forty minutes by sending a message from San Francisco to San Francisco in one-fourth of that time." Mr. Mackay was slightly hurt during the first attempt to land the shore end of the cable last week.

SUPERINTENDENT HESS, of the German Niles Tool Works, Berlin, is now in the United States. The report that the works had closed down is accurate. There was a strike recently among the employees, but the matter has been adjusted and the plant is now in full operation again. The Berlin works acquired the German rights to manufacture the specialties of the Niles Tool Works, of Hamilton, Ohio, prior to that concern's absorption by the Niles-Bement-Pond Company. The plant is an exact duplicate of the Ohio works. In view of the general business depression throughout the German Empire the German Niles Works have been offering on this market for some time past various machine tools for prompt delivery and at from 5 per cent. to 10 per cent. lower prices than those existing here, notwithstanding the machinery being subject to a 45 per cent. import duty. No orders to speak of, however, have been taken in the American markets so far. In England the German tools have met with better success. Vickers Son & Maxim having lately placed a fair sized contract with the German concern.

EDUCATIONAL.

GRADUATE SCHOOL OF ENGINEERING AT THE M. I. T.—A graduate school of engineering research is to be established Oct. 7, 1903, at the Massachusetts Institute of Technology in Boston. Its object will be to stimulate and provide research in such branches of fine and applied science as relate to the various departments of engineering, covering work in civil, sanitary, mechanical, electrical, marine, mining and chemical studies. The school will be composed of a limited number of graduate students of marked attainments presumably qualified to engage in advanced studies and investigation and the staff will consist partly of professors and instructors of the institute, and partly of experts and authorities actually engaged in engineering enterprises. Problems of immediate and practical importance are to be studied as far as means and facilities allow. Thus, $5,000 per year for three years has been offered by a friend of the institute to be expended in the study of efficient and economical methods of dealing with the sewage of large cities. Also a testing laboratory for the investigation of the behavior of building materials under exposure to fire. Another fund of $500 for three years has been tendered for the investigation of Röntgen Ray apparatus, with a view for its improvement for the uses of surgery and medicine. The degree of Doctor of Engineering (Eng. D.) will be conferred upon members of the school who have been duly accepted as candidates for that degree upon a residence membership of two years and an original thesis upon some approved subject, based upon sustained study of a particular problem which has been advanced by the candidate's work.

Trade Notes.

THE ELECTRIC APPLIANCE CO., Chicago, is out with the announcement that it has in Chicago ready for immediate shipment the largest stock of weather-proof wires carried by any house west of the Allegheny mountains.

STERLING ELECTRICAL MFG. CO., of Warren, Ohio, has recently issued a neat little folder circular discussing tersely the benefits and advantages of its incandescent lamps; the text being accompanied by cuts to emphasize the points.

STROMBERG-CARLSON TELEPHONE MFG. CO. reports a great many inquiries regarding its new hook-switch, which it has recently placed on the market. It is now equipping all its telephones with this new style hook, illustrations of which have appeared in this paper.

THE UNITED STATES CARBON COMPANY, a New Jersey corporation with $400,000 capital stock has been admitted to do business in Ohio with office in Cleveland. Burton L. Foster is president. The company is the re-organization of the old company of the same name.

THE CENTRAL ELECTRIC COMPANY, of Chicago, is distributing to the trade a new No. 9 D. & W. price list. This price list, which contains half-tone cuts of all D. & W. products, includes much new material not heretofore listed. Any prospective buyer can obtain a copy by addressing the above company.

THE CARPENTER MACHINE WORKS is the name of the successor to Hubbard & Carpenter, 93 Pearl St., Brooklyn, New York, whose vacuum pumps are so well known and extensively used in the electrical field. The new firm, headed by Mr. Thos. D. Carpenter, will increase the plant and continue to produce work of the same excellent quality that has given the old firm the good reputation it has always enjoyed.

THE WESTERN ELECTRIC COMPANY reports very gratifying results from its constant potential alternating arc lamp. This lamp operates on the repulsion principle and the favor with which the central station managers have received it, as well as the fact that a competing manufacturer has recently copied the details of its mechanism, are tributes to its intrinsic worth. The Western Electric Company will be pleased to quote attractive prices to prospective buyers.

D. & W. SPECIALTIES.—In a neat catalogue-price list just issued the D. & W. Fuse Company, Providence, R. I., displays in illustration a full line of non-arcing fuses and safety devices for alternating, power, railway, lighting, telephone and fire-alarm circuits. The list includes this company's indicating cartridge fuse, the indication of a blown fuse being the appearance of a burned spot in the center of a circle; service switches and boxes; subway boxes; fuse terminals, etc. The price-list gives the prices of every size in the different classes. This company's business is rapidly increasing, to better care for which it has recently enlarged its manufacturing plant to double the former capacity.

THE WESTERN ELECTRICAL SUPPLY CO., of St. Louis, has recently got out two very attractive catalogues of seasonable articles. One of them illustrates a most complete line of electrical toys and small motors and dynamos. While these are toys, they are perfect miniature reproductions of large apparatus, and are mechanically and electrically perfect in every detail. There has been an increase of the demand for this catalogue, and the line of material illustrated would certainly seem very meritorious. The company has also issued a new catalogue on miniature incandescent lamps and fittings, showing an especially fine line of socketless, series lamps, which can be used to great advantage in decorating rooms and trees for Christmas. It is mailed on application.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 9, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

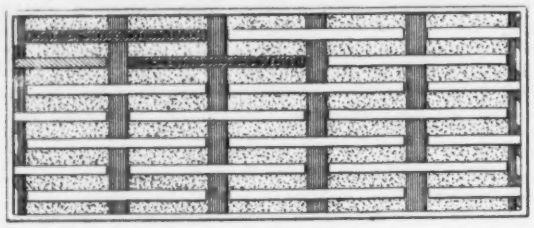
715,235. REVERSING SWITCH CONTROLLER FOR ELECTRIC MOTORS; J. I. Ayer, Malden, Mass. App. filed Feb. 17, 1902. The reversing switch and rheostat arm are interconnected by a latch which ensures their proper operation in sequence.

715,236. BOOSTER SYSTEM; G. Baehr, McKeesport, Pa. App. filed Feb. 14, 1902. A generator carries a field coil in circuit with the armature of a shunt-motor whereby an increase in the load on the motor will cause a proportionate increase in the strength of the field of the generator.

715,265. THERMO-ELECTRIC PILE; A. Heil, Frankfort-on-the-Main, Germany. App. filed April 22, 1902. One of the metals is so shaped that the heating flame will traverse a considerable length of it.

715,281. ELECTROLYTIC APPARATUS; Joseph Matthews, of Kings Heath, and William Davies, of Selby Park, England. App. filed March 29, 1901. An inner tank of perforated insulating material contains a revolving drum provided with a number of radiating arms passing through an outer surface of insulating material. The arms slowly carry the tin-scrap through the tank while it is being electrolyzed.

715,291. SYSTEM OF CONTROL FOR ELECTRICALLY PROPELLED VEHICLES; W. B. Potter, Schenectady, N. Y. App. filed April 8, 1899. The system comprises motor controllers operated by air pressure which is



715,413.—Storage Battery.

electromagnetically controlled and the arrangement is such that the controllers operate the motor circuits while the train is being driven and the brake circuit while it is being retarded.

715,299. ELECTRIC ELEVATOR; H. Rowntree, Chicago, Ill. App. filed Nov. 29, 1899. A push button system wherein the car can be automatically brought to any floor without interference from the operation of buttons at other floors.

715,313. PROCESS OF FORMING ELECTRIC CONDUCTING CABLES; R. Spaulding, New York, N. Y. App. filed May 3, 1902. The conductor is first formed into a tube by braiding together bare wires and is afterwards flattened, covered and given a rectangular shape.

715,327. RHEOSTAT; F. C. Watson, Philadelphia, Pa. App. filed April 2, 1902. A casing containing a number of lamps and a resistance coil, the latter having its convolutions projecting through an opening in the casing so that a contact finger can be moved across them.

715,329. RAIL CHAIR AND INSULATOR; W. D. Young, Baltimore, Md. App. filed Oct. 18, 1901. A chair for third rails having a dove-tailed opening for the insulator and side arms for supporting the guard rails.

715,332. ACCUMULATOR ELECTRODE; R. Alexander-Katz, Berlin, Germany. App. filed Aug. 31, 1899. Details.

715,334. ELECTRIC SAFE LOCK; J. M. Allen, St. Louis, Mo. App. filed June 7, 1901. A door without hinges or external handles is held in place by internal bolts controlled by electro-magnets. A handle in the form of a U and carrying magnet coils is applied to the front of the door at a certain point to complete the circuit of the internal magnets, which releases the bolts; the external magnet can then be used as a handle by reason of its sticking, to remove the door.

715,343. ACCUMULATOR; F. N. Blanc, Paris, France. App. filed Feb. 17, 1902. The support consists of aluminum electroplated with copper and covered with metallic lead.

715,347. TELEGRAPH; J. E. Carney, Montgomery, Ala. App. filed May 27, 1901. Details of a non-interfering box.

715,375. INSULATOR; M. Harloe, Hawley, Pa. App. filed May 9, 1902. (See page 1005.)

715,412. STORAGE BATTERY; L. Paget, New York, N. Y. App. filed Sept. 8, 1899. Silicated tufa is used as a filling between the plates on account of its being light and having great absorbent properties.

715,413. STORAGE BATTERY; L. Paget, New York, N. Y. App. filed Aug. 28, 1901. A multiple cell storage battery having plates extending edge-wise from one cell to another with the sole conducting connection between the cells formed by the active material.

715,415. ELECTRIC TROLLEY WIRE HANGER; A. Palmros, Columbus, Ohio. App. filed Sept. 24, 1897. A bracket supporting a pair of shear clamps which grip the wire.

715,428. ELECTRICAL CONTROLLER; J. L. Schureman, Jr., Chicago, Ill. App. filed Dec. 4, 1899. A power switch including a clutching arrangement whereby the circuit breaking switch is moved a certain distance and then released to allow the resistance controller to move.

715,434. ELECTROMAGNET; A. Stromberg, Chicago, Ill. App. filed Jan. 2, 1902. (See page 1005.)

715,455. SANITARY ATTACHMENT FOR TELEPHONE TRANSMITTERS; H. Baethig, Buffalo, N. Y. App. filed May 23, 1902. (See page 1005.)

715,505 and 715,506. ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed Nov. 21, 1901. (See page 1004.)

715,507. TUBULAR ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed Feb. 7, 1902. (See page 1004.)

715,508. ELECTRIC FURNACE; H. N. Potter, New Rochelle, N. Y. App. filed March 27, 1902. (See page 1004.)

715,509. END SUPPORT AND CIRCUIT TERMINAL FOR CARBON TUBE FURNACES; H. N. Potter, New Rochelle, N. Y. App. filed March 28, 1902. (See page 1004.)

715,511. SNAP SWITCH; H. E. Reeve, Brooklyn, N. Y. App. filed Feb. 12, 1902. Details of a pole switch.

715,528. FUSE BOX; M. R. Utley, Chicago, Ill. App. filed May 13, 1901. A box having a lining of installing material in which the fuse is mounted and having certain grooves and spaces to shed water.

715,537. COMPOSITE SYSTEM OF ELECTRICAL TRANSMISSION; F. Bedell, Ithaca, N. Y. App. filed March 20, 1900. (See page 1005.)

715,545. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, New York. App. filed June 22, 1896. (See Current News and Notes.)

715,546. GENERATING ALTERNATING CURRENTS; C. S. Bradley, Avon, New York. App. filed April 23, 1902. (See Current News and Notes.)

715,555. ELECTRIC SIGN; L. S. Crandall, Brooklyn, N. Y. App. filed Aug. 30, 1902. The sockets for the lamps can be filled by ornamental plugs to adapt the structure for a day sign as well as a night sign.

715,618. VENTILATED MAGNET COIL; W. Spencer, Jr., Schenectady, N. Y. App. filed May 23, 1902. A coarse helix with spaces between the convolutions, is wound next to the core to permit air to circulate therein.

715,625. PROCESS OF OBTAINING METALLIC ALUMINUM OR OTHER METALS BY ELECTROLYSIS; G. Taddei, Turin, Italy. App. filed July 17, 1901. (See page 1004.)

715,626. APPARATUS FOR OBTAINING METALS BY ELECTROLYSIS; G. Taddei, Turin, Italy. App. filed Dec. 13, 1901. (See page 1004.)

715,643. CARBON GUIDE FOR ELECTRIC LAMPS; W. J. Deming, Murphysboro, Ill. App. filed July 12, 1902. Details.

715,650. ELECTRICAL MASSAGE APPARATUS; O. A. En Holm, New York, N. Y. App. filed March 20, 1902. Details.

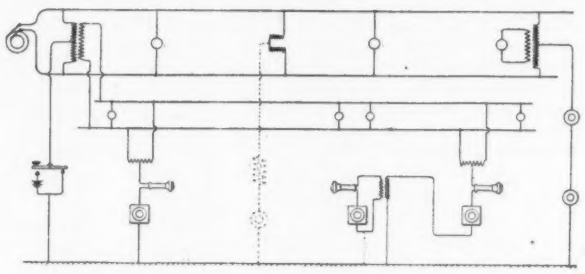
715,654. GRAVITY ELECTRIC BATTERY; A. M. Friend, Denver, Colo. App. filed June 8, 1901. A porous horizontal diaphragm is inserted between the upper and lower electrodes to act as a filter.

715,677. ELECTRIC ROLLER; C. J. Marius, West Hoboken, N. J. App. filed Feb. 6, 1900. A generator located inside of the roller supplies a current thereto while the roller is moved over the surface of the body in massaging treatment.

715,683. ELECTRICAL CALL BELL; W. E. McCormick, Chicago, Ill. App. filed Dec. 16, 1901. (See page 1005.)

715,684. ANODE; Frank McDonald, Johnsonburg, Pa. App. filed May 20, 1901. The anode comprises a tube or cup containing mercury, and a number of thin strips of platinum foil with one end sealed within the tube; a conductor enters the top of the tube.

715,686. ELECTRIC TELEGRAPH; T. D. Penniman, Baltimore, Md. App. filed Jan. 9, 1902. Intelligence is transmitted by sending over the circuit



715,537.—Composite System of Electrical Transmission.

a succession of impulses separated by spaces and substituting spaces for impulses and impulses for spaces in combinations to form the characters of a code.

715,689. ELECTRICAL SWITCH; C. D. Platt, Bridgeport, Conn. App. filed Aug. 19, 1902. The clips have V-shaped bases which fit into similarly shaped notches in the insulating block upon which the switch is mounted.

715,696. SYSTEM OF TELEGRAPHIC DISTRIBUTION; H. A. Rowland, Baltimore, Md. App. filed Dec. 11, 1901. A telegraph line having central stations at each end and one or more sub-stations from each central station which are connected thereto by a circuit relayed from the main line.

715,702. SYSTEM OF AND APPARATUS FOR CONTROLLING LIGHT EFFECTS; R. F. Spangenberg, New Orleans, La. App. filed Nov. 18, 1901. A machine by which the sliding colored screens can be manipulated by power to produce various effects for theatrical purposes.

715,714. TROLLEY FOR ELECTRIC RAILWAY CARS; L. E. Walkins, Springfield, Mass. App. filed Jan. 9, 1900. The trolley is hinged to the car and trails, so that it can raise and lower to compensate for inequalities in the conductor.

THE ELECTRICAL WORLD AND ENGINEER'S

MOONLIGHT TABLES FOR 1903

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

JANUARY, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	6.20 A.M.
2	5.15 "	3	6.20 "
3	5.15 "	4	6.20 "
4	5.15 "	5	6.20 "
5	5.15 "	6	6.20 "
6	5.15 "	7	6.20 "
7	5.15 "	8	6.20 "
8	5.20 P.M.	9	6.20 "
9	5.20 "	9	12.00 M.
10	5.20 "	10	12.00 "
11	5.20 "	11	12.00 "
12	5.20 "	12	12.00 "
13	5.25 P.M.	13	12.00 "
14	5.25 "	14	12.00 "
15	5.25 "	15	12.00 "
16	5.25 "	16	12.00 "
17	5.30 "	17	12.00 "
18	5.30 "	19	12.15 A.M.
19	5.30 "	20	1.15 "
20	5.30 "	21	2.15 "
21	5.30 "	22	3.10 "
22	5.35 "	23	4.05 "
23	5.35 "	24	4.55 "
24	5.35 "	25	5.45 "
25	5.35 "	26	6.15 "
26	5.40 "	27	6.15 "
27	5.40 "	28	6.15 "
28	5.40 "	29	6.15 "
29	5.40 "	30	6.15 "
30	5.45 "	31	6.10 "
31	5.45 "	1	6.10 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	6.20 A.M.
2	5.15 "	3	6.20 "
3	8.35 "	4	6.20 "
4	9.35 "	5	6.20 "
5	10.35 "	6	6.20 "
6	11.35 "	7	6.20 "
7	—	—	—
8	12.40 A.M.	8	6.20 "
9	1.45 "	9	6.20 "
10	2.55 "	10	6.20 "
11	4.00 "	11	6.20 "
12	5.00 "	12	6.20 "
13	No light.	13	No light.
14	"	14	
15	5.25 P.M.	15	8.55 P.M.
16	5.25 "	16	10.05 "
17	5.30 "	17	11.10 "
18	5.30 "	19	12.15 A.M.
19	5.30 "	20	1.15 "
20	5.30 "	21	2.15 "
21	5.30 "	22	3.10 "
22	5.35 "	23	4.05 "
23	5.35 "	24	4.55 "
24	5.35 "	25	5.45 "
25	5.35 "	26	6.15 "
26	5.40 "	27	6.15 "
27	5.40 "	28	6.15 "
28	5.40 "	29	6.15 "
29	5.40 "	30	6.15 "
30	5.45 "	31	6.10 "
31	5.45 "	1	6.10 "

FEBRUARY, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	6.10 A.M.
2	5.45 "	3	6.10 "
3	5.50 "	4	6.10 "
4	5.50 "	5	6.05 "
5	5.50 "	6	6.05 "
6	5.50 "	6	12.00 M.
7	1.45 A.M.	7	6.05 A.M.
7	5.50 P.M.	7	12.00 M.
8	5.50 "	8	12.00 "
9	5.50 "	9	12.00 "
10	5.50 "	10	12.00 "
11	5.50 "	11	12.00 "
12	6.00 "	12	12.00 "
13	6.00 "	13	12.00 "
14	6.00 "	14	12.00 "
15	6.05 "	15	12.00 "
16	6.05 "	16	12.00 "
17	6.05 "	18	1.00 A.M.
18	6.05 "	19	1.55 "
19	6.05 "	20	2.50 "
20	6.10 "	21	3.40 "
21	6.10 "	22	4.25 "
22	6.10 "	23	5.45 "
23	6.10 "	24	5.40 "
24	6.15 "	25	5.40 "
25	6.15 "	26	5.40 "
26	6.15 "	27	5.40 "
27	6.15 "	28	5.35 "
28	6.20 "	1	5.35 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	6.10 A.M.
2	9.25 "	3	6.10 "
3	10.30 "	4	6.10 "
4	11.35 "	5	6.05 "
5	—	—	—
6	12.40 A.M.	6	6.05 "
7	2.45 "	7	6.05 "
8	3.40 "	8	6.05 "
9	4.30 "	9	6.00 "
10	No light.	10	6.00 "
11	"	11	No light.
12	6.00 P.M.	12	"
13	6.00 "	13	8.45 P.M.
14	6.05 "	14	9.55 "
15	6.05 "	15	11.00 "
16	6.05 "	16	12.00 M.
17	6.05 "	18	1.00 A.M.
18	6.05 "	19	1.55 "
19	6.05 "	20	2.50 "
20	6.10 "	21	3.40 "
21	6.10 "	22	4.25 "
22	6.10 "	23	5.45 "
23	6.10 "	24	5.40 "
24	6.15 "	25	5.40 "
25	6.15 "	26	5.40 "
26	6.15 "	27	5.40 "
27	6.15 "	28	5.35 "
28	6.20 "	1	5.35 "

MARCH, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	5.35 A.M.
2	6.20 "	3	5.35 "
3	6.20 "	4	5.30 "
4	6.20 "	5	5.30 "
5	6.25 "	6	5.30 "
6	6.25 "	7	5.30 "
7	6.25 "	7	12.00 M.
8	1.30 A.M.	8	5.25 A.M.
8	6.25 P.M.	8	12.00 M.
9	2.25 A.M.	9	5.25 A.M.
9	6.25 P.M.	9	12.00 M.
10	6.30 "	10	12.00 "
11	6.30 "	11	12.00 "
12	6.30 "	12	12.00 "
13	6.30 "	13	12.00 "
14	6.35 "	14	12.00 "
15	6.35 "	15	12.00 "
16	6.35 "	16	12.00 "
17	6.35 "	17	12.00 "
18	6.35 "	19	12.40 A.M.
19	6.40 "	20	1.30 "
20	6.40 "	21	2.20 "
21	6.40 "	22	3.05 "
22	6.40 "	23	3.45 "
23	6.40 "	24	4.20 "
24	6.45 "	25	5.00 "
25	6.45 "	26	5.00 "
26	6.45 "	28	4.50 "
27	6.45 "	29	4.50 "
28	6.45 "	29	4.50 "
29	6.50 "	30	4.50 "
30	6.50 "	31	4.50 "
31	6.50 "	1	4.50 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	5.35 A.M.
2	6.20 "	3	5.35 "
3	6.20 "	4	5.30 "
4	10.30 "	5	5.30 "
5	11.35 "	6	5.30 "
6	—	—	—
7	12.35 A.M.	7	5.30 "
8	1.30 "	8	5.25 "
9	2.25 "	9	5.25 "
10	3.10 "	10	5.20 "
11	No light.	11	No light.
12	"	12	"
13	"	13	"
14	6.35 P.M.	14	8.40 P.M.
15	6.35 "	15	9.45 "
16	6.35 "	16	10.45 "
17	6.35 "	17	11.45 "
18	6.35 "	19	12.40 A.M.
19	6.40 "	20	1.30 "
20	6.40 "	21	2.20 "
21	6.40 "	22	3.05 "
22	6.40 "	23	3.45 "
23	6.40 "	24	4.20 "
24	6.45 "	25	5.00 "
25	6.45 "	26	5.00 "
26	6.45 "	27	5.00 "
27	6.45 "	28	4.50 "
28	6.45 "	29	4.50 "
29	6.50 "	30	4.50 "
30	6.50 "	31	4.50 "
31	6.50 "	1	4.50 "

APRIL, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	4.45 P.M.
2	6.50 "	3	4.45 "
3	6.55 "	4	4.45 "
4	6.55 "	5	4.40 A.M.
5	6.55 "	5	12.00 M.
6	1.10 A.M.	6	4.40 A.M.
6	6.55 P.M.	6	12.00 M.
7	1.50 A.M.	7	4.35 A.M.
7	6.55 P.M.	7	12.00 M.
8	7.00 "	8	12.00 "
9	7.00 "	9	12.00 "
10	7.00 "	10	12.00 "
11	7.00 "	11	12.00 "
12	7.00 "	12	12.00 "
13	7.05 "	13	12.00 "
14	7.05 "	14	12.00 "
15	7.05 "	15	12.00 "
16	7.05 "	17	12.10 A.M.
17	7.05 "	18	1.00 "
18	7.10 "	19	1.40 "
19	7.10 "	20	2.15 "
20	7.10 "	21	2.50 "
21	7.10 "	22	3.25 "
22	7.10 "	23	4.00 "
23	7.15 "	24	4.10 "
24	7.15 "	25	4.10 "
25	7.15 "	26	4.10 "
26	7.15 "	27	4.05 "
27	7.15 "	28	4.05 "
28	7.20 "	29	4.05 "
29	7.20 "	30	4.05 "
30	7.20 "	1	4.05 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	4.45 A.M.
2	10.30 "	3	4.45 "
3	11.30 "	4	4.45 "
4	—	—	—
5	12.20 A.M.	5	4.40 A.M.
6	1.10 "	6	4.40 "
7	1.50 "	7	4.35 "
8	2.30 "	8	4.35 "
9	3.00 "	9	4.35 "
10	No light.	10	No light.
11	"	11	"
12	"	12	
13	7.05 P.M.	13	9.30 P.M.
14	7.05 "	14	10.30 "
15	7.05 "	15	11.20 "
16	7.05 "	17	12.10 A.M.
17	7.05 "	18	1.00 "
18	7.10 "	19	1.40 "
19	7.10 "	20	2.15 "
20	7.10 "	21	2.50 "
21	7.10 "	22	3.25 "
22	7.10 "	23	4.00 "
23	7.15 "	24	4.10 "
24	7.15 "	25	4.10 "
25	7.15 "	26	4.10 "
26	7.15 "	27	4.05 "
27	7.15 "	28	4.05 "
28	7.20 "	29	4.05 "
29	7.20 "	30	4.05 "
30	7.20 "	1	4.05 "

MAY, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	4.00 A.M.
2	7.20 "	3	4.00 "
3	7.25 "	4	4.00 "
4	7.25 "	5	4.00 "
5	7.25 "	5	12.00 M.
6	1.10 A.M.	6	3.55 A.M.
6	7.25 P.M.	6	12.00 M.
7	1.40 A.M.	7	3.55 A.M.
7	7.25 P.M.	7	12.00 M.
8	7.30 "	8	12.00 "
9	7.30 "	9	12.00 "
10	7.30 "	10	12.00 "
11	7.30 "	11	12.00 "
12	7.30 "	12	12.00 "
13	7.35 "	13	12.00 "
14	7.35 "	14	12.00 "
15	7.35 "	15	12.00 "
16	7.35 "	17	12.15 A.M.
17	7.35 "	18	12.50 "
18	7.35 "	19	1.25 "
19	7.40 "	20	2.00 "
20	7.40 "	21	2.30 "
21	7.40 "	22	3.00 "
22	7.40 "	23	3.30 "
23	7.40 "	24	3.40 "
24	7.40 "	25	3.40 "
25	7.45 "	26	3.40 "
26	7.45 "	27	3.40 "
27	7.45 "	28	3.35 "
28	7.45 "	29	3.35 "
29	7.45 "	30	3.35 "
30	7.45 "	31	3.35 "
31	7.50 "	1	3.35 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	10.15 P.M.	2	4.00 A.M.
2	11.05 "	3	4.00 "
3	11.50 "	4	4.00 "
4	—	—	—
5	12.30 A.M.	5	3.55 A.M.
6	1.10 "	6	3.55 "
7	1.40 "	7	3.55 "
8	2.15 "	8	3.55 "
9	2.50 "	9	3.50 A.M.
10	No light.	10	No light.
11	"	11	"
12	"	12	
13	7.35 P.M.	13	10.05 P.M.
14	7.35 "	14	10.50 "
15	7.35 "	15	11.35 "
16	7.35 "	17	12.15 A.M.
17	7.35 "	18	12.50 "
18	7.35 "	19	1.25 "
19	7.40 "	20	2.00 "
20	7.40 "	21	2.30 "
21	7.40 "	22	3.00 "
22	7.40 "	23	3.30 "
23	7.40 "	24	3.40 "
24	7.40 "	25	3.40 "
25	7.45 "	26	3.40 "
26	7.45 "	27	3.40 "
27	7.45 "	28	3.35 "
28	7.45 "	29	3.35 "
29	7.45 "	30	3.35 "
30	7.45 "	31	3.35 "
31	10.30 "	1	3.35 "

JUNE, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	3.35 P.M.
2	7.50 "	3	3.35 "
3	7.50 "	4	3.30 "
4	7.50 "	4	12 M.
5	12.50 A.M.	5	3.30 A.M.
5	7.50 P.M.	5	12.00 M.
6	1.30 A.M.	6	3.30 A.M.
6	7.55 P.M.	6	12.00 M.
7	7.55 "	7	12.00 "
8	7.55 "	8	12.00 "
9	7.55 "	9	12.00 "
10	7.55 "	10	12.00 "
11	7.55 "	11	12.00 "
12	7.55 "	12	12.00 "
13	7.55 "	13	12.00 "
14	7.55 "	14	12.00 "
15	7.55 "	15	12.00 "
16	7.55 "	17	12.30 A.M.
17	8.00 P.M.	18	1.00 "
18	8.00 "	19	1.30 "
19	8.00 "	20	2.00 "
20	8.00 "	21	2.40 "
21	8.00 "	22	3.20 "
22	8.00 "	23	3.30 "
23	8.00 "	24	3.30 "
24	8.00 "	25	3.30 "
25	8.00 "	26	3.30 "
26	8.00 "	27	3.30 "
27	8.00 "	28	3.30 "
28	8.00 "	29	3.30 "
29	8.00 "	30	3.30 "
30	8.00 "	1	3.30 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	11.10 P.M.	2	3.35 A.M.
2	11.45 "	3	3.35 "
3	—	—	—
4	12.20 A.M.	4	3.30 A.M.
5	12.50 "	5	3.30 "
6	1.30 "	6	3.30 "
7	2.00 "	7	3.30 "
8	No light.	8	No light.
9	"	9	"
10	"	10	"
11	7.55 P.M.	11	9.30 P.M.
12	7.55 "	12	10.15 "
13	7.55 "	13	10.50 "
14	7.55 "	14	11.25 "
15	7.55 "	15	12.00 M.
16	7.55 "	17	12.30 A.M.
17	8.00 "	18	1.00 "
18	8.00 "	19	1.30 "
19	8.00 "	20	2.00 "
20	8.00 "	21	2.40 "
21	8.00 "	22	3.20 "
22	8.00 "	23	3.30 "
23	8.00 "	24	3.30 "
24	8.00 "	25	3.30 "
25	8.00 "	26	3.30 "
26	8.00 "	27	3.30 "
27	8.00 "	28	3.30 "
28	8.00 "	29	3.30 "
29	8.00 "	30	3.30 "
30	10.20 "	1	3.30 "

JULY, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 P.M.	2	3.35 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	4	12.00 M.
5	12.45 A.M.	5	3.35 A.M.
5	8.00 P.M.	5	12.00 M.
6	8.00 "	6	12.00 "
7	8.00 "	7	12.00 "
8	8.00 "	8	12.00 "
9	8.00 "	9	12.00 "
10	8.00 "	10	12.00 "
11	8.00 "	11	12.00 "
12	8.00 "	12	12.00 "
13	8.00 "	13	12.00 "
14	8.00 "	14	12.00 "
15	8.00 "	15	12.00 "
16	8.00 "	16	12.00 "
17	8.00 "	18	12.40 A.M.
18	8.00 "	19	1.15 "
19	8.00 "	20	2.00 "
20	7.55 "	21	2.50 "
21	7.55 "	22	3.45 "
22	7.55 "	23	3.50 "
23	7.55 "	24	3.50 "
24	7.55 "	25	3.50 "
25	7.55 "	26	3.50 "
26	7.50 "	27	3.50 "
27	7.50 "	28	3.50 "
28	7.50 "	29	3.50 "
29	7.50 "	30	3.55 "
30	7.50 "	31	3.55 "
31	7.50 "	1	3.55 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	10.55 P.M.	2	3.35 A.M.
2	11.30 "	3	3.35 "
3	—	—	—
4	12.05 A.M.	4	3.35 "
5	12.45 "	5	3.35 "
6	1.25 "	6	3.35 "
7	2.05 "	7	3.40 "
8	No light.	8	No light.
9	"	9	"
10	"	10	"
11	8.00 P.M.	11	9.30 P.M.
12	8.00 "	12	10.00 "
13	8.00 "	13	10.30 "
14	8.00 "	14	11.00 "
15	8.00 "	15	11.30 "
16	8.00 "	17	12.05 A.M.
17	8.00 "	18	12.40 "
18	8.00 "	19	1.15 "
19	8.00 "	20	2.00 "
20	7.55 "	21	2.50 "
21	7.55 "	22	3.45 "
22	7.55 "	23	3.50 "
23	7.55 "	24	3.50 "
24	7.55 "	25	3.50 "
25	7.55 "	26	3.50 "
26	7.50 "	27	3.50 "
27	7.50 "	28	3.50 "
28	7.50 "	29	3.50 "
29	9.30 "	30	3.55 "
30	10.05 "	31	3.55 "
31	10.40 "	1	3.55 "

AUGUST, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	4.00 A.M.
2	7.45 "	3	4.00 "
3	7.45 "	3	12.00 M.
4	1.00 A.M.	4	4.00 A.M.
4	7.45 P.M.	4	12.00 M.
5	7.45 "	5	12.00 "
6	7.40 "	6	12.00 "
7	7.40 "	7	12.00 "
8	7.40 "	8	12.00 "
9	7.40 "	9	12.00 "
10	7.35 "	10	12.00 "
11	7.35 "	11	12.00 "
12	7.35 "	12	12.00 "
13	7.35 "	13	12.00 "
14	7.30 "	14	12.00 "
15	7.30 "	15	12.00 "
16	7.30 "	17	12.40 A.M.
17	7.25 "	18	1.30 "
18	7.25 "	19	2.30 "
19	7.25 "	20	3.35 "
20	7.25 "	21	4.15 "
21	7.20 "	22	4.15 "
22	7.20 "	23	4.15 "
23	7.20 "	24	4.20 "
24	7.20 "	25	4.20 "
25	7.15 "	26	4.20 "
26	7.15 "	27	4.20 "
27	7.15 "	28	4.20 "
28	7.10 "	29	4.20 "
29	7.10 "	30	4.25 "
30	7.10 "	31	4.25 "
31	7.05 "	1	4.25 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	11.20 P.M.	2	4.00 A.M.
2	—	—	—
3	12.10 A.M.	3	4.00 A.M.
4	1.00 "	4	4.00 "
5	1.35 "	5	4.00 "
6	2.30 "	6	4.00 "
7	No light.	7	No light.
8	"	8	"
9	"	9	"
10	7.35 P.M.	10	9.05 P.M.
11	7.35 "	11	9.35 "
12	7.35 "	12	10.05 "
13	7.35 "	13	10.40 "
14	7.30 "	14	11.15 "
15	7.30 "	15	11.55 "
16	7.30 "	17	12.40 A.M.
17	7.25 "	18	1.30 "
18	7.25 "	19	2.30 "
19	7.25 "	20	3.35 "
20	7.20 "	21	4.15 "
21	7.20 "	22	4.15 "
22	7.20 "	23	4.15 "
23	7.20 "	24	4.20 "
24	7.20 "	25	4.20 "
25	7.15 "	26	4.20 "
26	7.15 "	27	4.20 "
27	8.40 "	28	4.20 "
28	9.20 "	29	4.20 "
29	10.00 "	30	4.25 "
30	10.50 "	31	4.25 "
31	11.40 "	1	4.25 "

SEPTEMBER, 1903

TABLE No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.30 A.M.
2	7.05 "	3	4.30 "
3	7.05 "	3	12.00 M.
4	7.00 "	4	12.00 "
5	7.00 "	5	12.00 "
6	7.00 "	6	12.00 "
7	6.55 "	7	12.00 "
8	6.55 "	8	12.00 "
9	6.55 "	9	12.00 "
10	6.50 "	10	12.00 "
11	6.50 "	11	12.00 "
12	6.50 "	12	12.00 "
13	6.45 "	13	12.00 "
14	6.45 "	15	12.20 A.M.
15	6.45 "	16	1.20 "
16	6.40 "	17	2.25 "
17	6.40 "	18	3.35 "
18	6.40 "	19	4.45 "
19	6.35 "	20	4.45 "
20	6.35 "	21	4.45 "
21	6.35 "	22	4.45 "
22	6.30 "	23	4.45 "
23	6.30 "	24	4.45 "
24	6.30 "	25	4.50 "
25	6.25 "	26	4.50 "
26	6.25 "	27	4.50 "
27	6.25 "	28	4.50 "
28	6.20 "	29	4.50 "
29	6.20 "	30	4.50 "
30	6.20 "	1	4.55 "

TABLE No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	—	—	—
2	12.25 A.M.	2	4.30 A.M.
3	1.10 "	3	4.30 "
4	2.15 "	4	4.30 "
5	3.10 "	5	4.30 "
6	No light.	6	No light.
7	"	7	"
8	"	8	"
9	6.55 P.M.	9	8.45 P.M.
10	6.50 "	10	9.20 "
11	6.50 "	11	9.55 "
12	6.50 "	12	10.40 "
13	6.45 "	13	11.25 "
14	6.45 "	15	12.20 A.M.
15	6.45 "	16	1.20 "
16	6.40 "	17	2.25 "
17	6.40 "	18	3.35 "
18	6.40 "	19	4.45 "
19	6.35 "	20	4.45 "
20	6.35 "	21	4.45 "
21	6.35 "	22	4.45 "
22	6.30 "	23	4.45 "
23	6.30 "	24	4.45 "
24	6.30 "	25	4.50 "
25	7.55 "	26	4.50 "
26	8.40 "	27	4.50 "
27	9.30 "	28	4.50 "
28	10.20 "	29	4.50 "
29	11.10 "	30	4.50 "
30	12.00 M.	1	4.55 "

OCTOBER, 1903

TABLE No. 1. Frund's Moonlight System.

TABLE No. 2. Standard Moonlight System.

NOVEMBER, 1903

TABLE No. 1. Frund's Moonlight System.

TABLE No. 2. Standard Moonlight System.

DECEMBER, 1903

TABLE No. 1. Frund's Moonlight System.

TABLE No. 2 Standard Moonlight System.

31	7.50 "	1	3.55 "					31	7.05 "	1	4.25 "				

OCTOBER, 1903

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	3	12.00 M.
4	6.10 "	4	12.00 "
5	6.10 "	5	12.00 "
6	6.10 "	6	12.00 "
7	6.05 "	7	12.00 "
8	6.05 "	8	12.00 "
9	6.05 "	9	12.00 "
10	6.05 "	10	12.00 "
11	6.00 "	11	12.00 "
12	6.00 "	12	12.00 "
13	6.00 "	14	12.15 A.M.
14	5.55 "	15	1.25 "
15	5.55 "	16	2.30 "
16	5.55 "	17	3.40 "
17	5.50 "	18	4.50 "
18	5.50 "	19	5.15 "
19	5.50 "	20	5.15 "
20	5.45 "	21	5.15 "
21	5.45 "	22	5.15 "
22	5.45 "	23	5.15 "
23	5.45 "	24	5.20 "
24	5.40 "	25	5.20 "
25	5.40 "	26	5.20 "
26	5.40 "	27	5.20 "
27	5.35 "	28	5.20 "
28	5.35 "	29	5.20 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	1	5.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	——	—	——
2	1.00 A.M.	2	4.55 A.M.
3	1.55 "	3	4.55 "
4	2.55 "	4	5.00 "
5	3.55 "	5	5.00 "
6	No light.	6	No light.
7	"	7	"
8	6.05 P.M.	8	8.00 P.M.
9	6.05 "	9	8.40 "
10	6.05 "	10	9.25 "
11	6.00 "	11	10.15 "
12	6.00 "	12	11.15 "
13	6.00 "	14	12.15 A.M.
14	5.55 "	15	1.25 "
15	5.55 "	16	2.30 "
16	5.50 "	17	3.40 "
17	5.50 "	18	4.50 "
18	5.50 "	19	5.15 "
19	5.45 "	20	5.15 "
20	5.45 "	21	5.15 "
21	5.45 "	22	5.15 "
22	5.45 "	23	5.15 "
23	5.45 "	24	5.20 "
24	5.40 "	25	5.20 "
25	8.10 "	26	5.20 "
26	9.00 "	27	5.20 "
27	10.00 "	28	5.20 "
28	10.50 "	29	5.20 "
29	11.45 "	30	5.25 "
30	——	—	——
31	12.40 A.M.	31	5.25 "

NOVEMBER, 1903

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.30 A.M.
2	5.30 "	2	12.00 M.
3	5.30 "	3	12.00 "
4	5.30 "	4	12.00 "
5	5.25 "	5	12.00 "
6	5.25 "	6	12.00 "
7	5.25 "	7	12.00 "
8	5.25 "	8	12.00 "
9	5.20 "	9	12.00 "
10	5.20 "	10	12.00 "
11	5.20 "	12	12.20 A.M.
12	5.20 "	13	1.30 "
13	5.20 "	14	2.40 "
14	5.15 "	15	3.45 "
15	5.15 "	16	4.50 "
16	5.15 "	17	5.50 "
17	5.15 "	18	5.50 "
18	5.15 "	19	5.50 "
19	5.15 "	20	5.50 "
20	5.15 "	21	5.50 "
21	5.10 "	22	5.50 "
22	5.10 "	23	5.55 "
23	5.10 "	24	5.55 "
24	5.10 "	25	5.55 "
25	5.10 "	26	5.55 "
26	5.10 "	27	5.55 "
27	5.10 "	28	6.00 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.10 "	1	6.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	1.40 A.M.	1	5.25 A.M.
2	2.40 "	2	5.30 "
3	3.40 "	3	5.30 "
4	No light.	4	No light.
5	"	5	"
6	5.25 P.M.	6	7.20 P.M.
7	5.25 "	7	8.10 "
8	5.25 "	8	9.10 "
9	5.20 "	9	10.10 "
10	5.20 "	10	11.15 "
11	5.20 "	12	12.20 A.M.
12	5.20 "	13	1.30 "
13	5.20 "	14	2.40 "
14	5.15 "	15	3.45 "
15	5.15 "	16	4.50 "
16	5.15 "	17	5.50 "
17	5.15 "	18	5.50 "
18	5.15 "	19	5.50 "
19	5.15 "	20	5.50 "
20	5.15 "	21	5.50 "
21	5.10 "	22	5.50 "
22	5.10 "	23	5.55 "
23	5.10 "	24	5.55 "
24	8.40 "	25	5.55 "
25	9.35 "	26	5.55 "
26	10.30 "	27	5.55 "
27	11.25 "	28	6.00 "
28	——	—	——
29	12.25 A.M.	29	6.00 "
30	1.25 "	30	6.00 "

DECEMBER, 1903

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	1	12.00 M.
2	5.05 "	2	12.00 "
3	5.05 "	3	12.00 "
4	5.05 "	4	12.00 "
5	5.05 "	5	12.00 "
6	5.05 "	6	12.00 "
7	5.05 "	7	12.00 "
8	5.05 "	8	12.00 "
9	5.05 "	9	12.00 "
10	5.05 "	11	12.30 A.M.
11	5.05 "	12	1.35 "
12	5.05 "	13	2.40 "
13	5.05 "	14	3.45 "
14	5.05 "	15	4.45 "
15	5.05 "	16	5.50 "
16	5.05 "	17	6.15 "
17	5.05 "	18	6.15 "
18	5.05 "	19	6.15 "
19	5.05 "	20	6.15 "
20	5.05 "	21	6.15 "
21	5.05 "	22	6.20 "
22	5.05 "	23	6.20 "
23	5.05 "	24	6.20 "
24	5.05 "	25	6.20 "
25	5.05 "	26	6.20 "
26	5.05 "	27	6.20 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	31	12.00 M.

Table No. 2 Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	2.25 A.M.	1	6.00 A.M.
2	3.25 "	2	6.00 "
3	4.30 "	3	6.00 "
4	No light.	4	No light.
5	"	5	"
6	5.05 P.M.	6	8.00 P.M
7	5.05 "	7	9.00 "
8	5.05 "	8	10.15 "
9	5.05 "	9	11.20 "
10	5.05 "	11	12.30 A.M.
11	5.05 "	12	1.35 "
12	5.05 "	13	2.40 "
13	5.05 "	14	3.45 "
14	5.05 "	15	4.45 "
15	5.05 "	16	5.50 "
16	5.05 "	17	6.15 "
17	5.05 "	18	6.15 "
18	5.05 "	19	6.15 "
19	5.05 "	20	6.15 "
20	5.05 "	21	6.15 "
21	5.05 "	22	6.20 "
22	5.05 "	23	6.20 "
23	8.20 "	24	6.20 "
24	9.15 "	25	6.20 "
25	10.10 "	26	6.20 "
26	11.10 "	27	6.20 "
27	——	—	——
28	12.10 A.M.	28	6.20 "
29	1.10 "	29	6.20 "
30	2.10 "	30	6.20 "
31	3.15 "	31	6.20 "